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THE NEW YORK CENTRAL.

It is an important statement that is published in our issue this week from the directors of the New York Central Railroad, as to their early use of electricity in the Park Avenue tunnel for suburban traffic. To what extent the recent sad accident has hastened this decision we cannot say, but it is a fact within our own knowledge, and one that we have already recorded in these columns, that the company has for months past been studying this problem with the aid of some of the best electrical engineering ability in this country. We have no doubt that the company in its slow and rather old-fashioned way will reinforce itself with the best advice as to the general plans now said to be ready for adoption, for its own satisfaction equally with that of the public. There would be wisdom in this, however, in more respects than one, and especially in view of the manner in which every act of the company is viewed in some quarters.

The definite plan announced is that of operating the suburban trains by electricity through the existing side tunnels, "equipped with the most modern appliances for underground traction." This phrase does not commit the company to third-rail methods, and does not exclude an overhead contact. It would appear, however, to involve the use of electric locomotives. The phrase, "suburban trains," has a rather elastic meaning, but in the case of the New York Central would presumably include all commuter service, although we have heard of daily commuters living as far out as Poughkeepsie.

This first step towards the general adoption of electricity is cautious and tentative, but we think that once the start is made, there will be no going back until the tunnel is wholly purged of steam and smoke, and the entire Central system is "electrified." The change may extend over years, but if we can read the signs of the times aright it is coming. The expense involved in the preliminary installment is quite considerable, and the statement we publish is supplemented by the news that the company is to raise $35,000,000 from its present stockholders, half of which will be subscribed immediately for the work. We are heartily glad that this conclusion has been reached, for even upon its surface it implies better service to the community and an increase of the facilities for travel and connection between lines without the city, and those within. We do not apprehend that the Legislature will dare oppose measures necessary to enable the company to carry out its plans and adopt electricity.

MARCONI AT THE A. I. E. E. ANNUAL DINNER

One of the most successful occasions in the history of the American Institute of Electrical Engineers was the annual dinner of that body this week, at which Signor Marconi was the guest of honor. Though the committee in charge of the affair had but a few days in which to plan and complete all arrangements—and these in several respects were quite elaborate—the affair passed off without a hitch. It is worth noting that Institute functions are, as a rule, admirably conducted. This, however, is not so surprising when one considers that they are in charge of men who, as engineers, are accustomed to dealing with matters not only involving great detail, but which have to be carried out with almost mathematical precision.

In the extended accounts of the dinner which appeared the following day in the newspaper press, the modesty of demeanor and speech of the guest of honor was much dwelt upon. Newspaper writers had apparently expected a grandiloquence of expression and generosity of prediction, such as have too often characterized the public utterances of those whose names have become deservedly prominent in connec-

tion with some subject that has attracted wide attention; for some members of this class mistake natural interest in the subject of their work, for admiration of their personality, and then endeavor to heighten personal appreciation by sensational statements. Those present who had closely followed the career of Signor Marconi were but confirmed in their opinion of his personal modesty by his bearing, and by his deliberation and care of statement, as manifested during the evening in his remarks. Though a very young man, he has the mental poise which usually is only associated with mature age, and the excellent form of his remarks is more characteristic of the savant than of the practical worker.

It will be recalled that in the five years or more in which his name has been prominently before the world, Signor Marconi has at no time announced what he expected to accomplish, in every case the public having obtained knowledge of his plans only after they had been carried to successful completion. To this is largely due the confidence he has inspired and which caused his unsupported statement as to the reception of the famous signal at St. Johns to be accepted without question by all who knew of the man. At the dinner Professor Elihu Thomson said that when asked by a newspaper reporter if he placed confidence in Marconi's statement, he replied, "If Marconi said he did it, I believe he did"—which is the same reply made to a newspaper reporter by Edison; and Dr. Pupin, in his remarks at the dinner, said that he would not now believe that the signals had been received if he did not know Mr. Marconi personally. Surely this is a case of a virtue meeting with merited reward.

In his remarks at the dinner Signor Marconi cleared up the misapprehension as to his syntonic system which had arisen from the fact that it has not as yet been put into commercial use. Thus far the commercial use of the wireless telegraph system has been to communicate with ships, and as pointed out by Signor Marconi, a syntonic system for this purpose would not only not be necessary, but would be disadvantageous. The statement of his belief in the practicability of syntonic telegraphy, and that he has proceeded far in the development of such a system, is perhaps the most important part in his address. It was doubtless due to his confidence in this system that he expressed a strong belief that wireless telegraphy eventually will be a real competitor of the submarine cable, though not necessarily superseding it. Commenting upon this later in the evening, Dr. Pupin directed attention to the fact that even if wireless telegraphy were to be a competitor of submarine telegraphy, it did not signify that the latter industry would necessarily be endangered; and, as an illustration, he pointed out how the competition of electric lighting has aided the gas industry and enhanced rather than decreased the value of investments in that industry. He instanced also telegraphy and telephony. It would, in fact, be hard to name one real beneficent invention that has been wiped out by another.

THE CARNEGIE INSTITUTION.

Among many striking acts of benevolence Mr. Andrew Carnegie has done no finer or wiser thing than his recent gift founding a national institution for the promotion of research. We are heartily glad that he has not merely founded another university. Of such, doing sterling work up to the limitations of their equipment, we have have enough and to spare. There is no section of the country where a young man cannot obtain a sound collegiate or technical education, but collegiate institutions are of necessity devoted mainly to the fundamental and necessary work of instruction, and can undertake serious research work only in a fragmentary way. Of post-graduate institutions there are comparatively few, and, for the most part, their work is the higher work of educational training rather than pure research. The great achievements of German science are due to the body of trained investigators who, having already attained the doctorate, devote their subsequent years to advancing the bounds of human knowledge. They are gathered about the various universities often in the position *privat-docent*, gradually working their way into prominence. In the English universities the Fellows form a similar body of enthusiastic workers in special lines. The great source of weakness in our own country so far as research is concerned is the lack of investigators holding this sort of relation to the universities. Unless a man is the lucky possessor of a private fortune he is compelled, as soon as he obtains his degree, to assume the position of instructor in some institution overburdened with students, and thenceforth his time is so taken up with the routine of instruction that his usefulness as an investigator is seriously impaired. Even if he finds time for original work the resources of most American institutions are so absorbed by work of instruction that they have scant funds to apply to even the material of research.

Hence, while we have plenty of places where proper instruction can be obtained, albeit insufficiently endowed, there are few opportunities for those who would settle down to serious scientific work. Nor is there any proper co-ordination of resources such as enables scientific work to be done with economy of effort. A brilliant young chemist, for example, has to take a place in some technical school that is struggling to build up a strong course in mathematical engineering, or a particularly clever astronomer finds himself marooned in a biological desert. We have in mind not a few unfortunate misfits of this kind that represent a real and great loss to science. Now the full plans of the splendid Carnegie Institution have not been made public, if, indeed, they have been completely formulated, but it is evident enough that they may include work of inestimable value to American science and arts. The location of the Institution at Washington, where the immense resources of the Government scientific departments can be co-ordinated with it for the maximum of mutual helpfulness, is a particularly wise step. We believe it is better out of direct government control, although the Government will assuredly join forces with it in its noble work. But its usefulness will assuredly not be limited to gathering a body of advanced students and investigators in Washington. It will be in a position to stretch out a helping hand to promote investigation in pure or applied science elsewhere. Those who know what the Rumford and Bache funds have done with comparatively little to promote American science can realize something of the extra-mural power for good that the Carnegie Institution may have. It is within its scope, in fact, to organize American investigation into coherent lines, and in no small measure to direct its progress. Free from the necessity of caring for a great body of elementary students it can put its resources where they will do the most good and produce the most valuable results.

To electrical science in particular it can be of immense service. There are many problems that require the most vigorous attacks on the part of trained and skillful investigators, but there was little prospect for their solution in this country. No work in electricity is merely of academic interest—the theory of yesterday and to-day is the practice of to-morrow. Yet much important work is apparently of so remote practical bearing that the great electrical manufacturers cannot see their way clear to undertaking it, and if done at all it must be attempted by hard working instructors in the crowded electrical departments of colleges and technical schools. The material of modern investigation is costly, and not a little important work has been blocked by insufficient appropriations. A foundation big enough and broad enough to undertake helpful development of great beginnings can confer inestimable benefits. Obviously no institution could fairly undertake much in the direct line of promoting practical im-

provements in the arts, nor is it necessary that it should do so, for in most cases they can take care of themselves if of real merit. But a wise and far-seeing outlook over the field of science can detect many a line of advance before the workers in the fields can recognize its true bearing. Both in theory and practice the Carnegie Institution will have an almost unlimited field for good before it. But to our minds its greatest opportunity is in the work of co-ordination, of strengthening American investigation where it is weak, of bringing united effort to bear where united effort will count, of reaching out to various points and attacking a pending problem from all sides. In endowing such an institution, Mr. Carnegie has earned the heartiest gratitude of his countrymen, and conferred a benefit, the greatness of which can hardly yet be realized.

THE ELECTRICAL SECTION OF THE INTERNATIONAL ENGINEERING CONGRESS, GLASGOW, 1901.

The December (1901) number of the *Journal of the Institution of Electrical Engineers* (London) contains six papers of considerable engineering interest, read before Section IX. of the Glasgow International Engineering Congress last September. Perhaps the most interesting was the paper describing the design and experimental preparatory work in connection with the construction of a 3000-horse-power, high-speed railway car for the German military railway between Berlin and Zossen. This paper is splendidly illustrated, and is a model of compactness with breadth of information. The general features of this experimental car are well known to our readers from the accounts that have been published from time to time. The car was equipped with four 750-horse-power triphase, 400-volt induction motors, their secondaries being wound two-phase to simplify rheostat connections. Transformers for stepping down from 12 kilovolts, are carried on the car, an arrangement which while having the disadvantage of adding to the weight to be moved an amount equal to half the total weight of motors, yet has the advantage of permitting smaller trolley wires to be used throughout the system, and greatly diminishing the cost of conductors. Numerous difficulties are necessarily encountered in the first development of a speed of 200 kilometers per hour with a 3000-horse-power induction-motor equipment. One of the principal difficulties in design appears to have been the spring support of the induction motors. These were finally carried on sleeves covering the axles, and spring-connected with the wheels. Very interesting three-dimension diagrams in isometric projection are given graphically representing the experimentally observed temperature elevation of the bearings, for different speeds of rotation, in association with different coefficients of friction. This type of diagrams is evidently capable of being introduced with advantage into many engineering applications.

The control of the motors is entirely by the aid of secondary resistance, using a very ingenious form of soda-water rheostat in which the electrodes are stationary, the liquid level being varied by a small electrically-driven pump, through which the electrolyte is kept constantly circulating. By this means the motorman is prevented from turning the current on too rapidly at starting. For stopping there are no less than three independent sets of brakes, the first being a hand-applied brake for shunting, the second a Westinghouse air-brake system, and the third an electric brake in which the line connection is shut off, and the stator of the motors excited by direct current from a storage battery on the car, while the rotor is gradually short circuited. It is clear that the limitations of rheostatic control and braking determine the commercial limits of this system. There can be no doubt of the great simplicity of the equipment and of its safety and readiness of control, which, in fact, were satisfactorily demonstrated in the recent Zossen trials. On the other hand, none of the energy of momentum is restored to the line when the car is stopped, and for all speeds below the maximum the rheostats must be kept in service with more or less attendant waste of energy. Such a system, while not so objectionable for long-distance passenger traffic at high speeds, does not appear to be adapted to short-distance running with frequent starting and stopping. If the speed control and braking of the car could be effected with a greater efficiency and saving of energy, not only would the generator installation at the central station be greatly reduced, but the system would be much more likely to supersede the ordinary direct-current street railway system. For very high speeds and long distances, however, the triphase induction-motor car equipment seems to have special advantages.

DANGERS FROM TROLLEY WIRES AND THEIR PREVENTION.

This is the title of a paper read at the Glasgow Engineering Congress by Professor A. Jamieson. The paper points out the dangers which exist when telegraph, telephone and lighting wires overhang and cross trolley wires. In several British cities attempts have been made to protect overhanging wires against trolley-wire contacts in case of rupture by supporting a wooden strip on the upper side of the trolley wire. This method has, however, been found to be either ineffective, or at least incompletely effective. The British Post Office rules require two guard wires over each trolley wire, the guard wires being 16 inches apart, and on the same level 2 ft. above the trolley wire. These guard wires are usually about the size of No. 5 B. & S. gauge. It is advocated, very properly, that the only safe method of installing these guard wires is to keep them well and permanently grounded at suitable short intervals. After discussing the various methods of preventing accidents by crosses between trolley wires and other neighboring non-trolley wires, in cases of accidental rupture, the paper takes the position that the only safe and sure plan of preventing crosses is to have no non-trolley wires. In other words, it advocates burying all telegraph, telephone and lighting wires. This is, of course, the correct solution of the difficulty in large cities where the expense of underground wires can be met without serious difficulty. It is no solution of the difficulty in villages and small towns where it is practically impossible to place the non-trolley wires underground. In such cases, however, not only is the danger of accident much reduced by reason of the reduced density of population, but it is possible to minimize the danger of accident by exercising ordinary care in construction.

MODERN COMMUTATING DYNAMO MACHINERY.

This is the title of a third paper read at the Glasgow Congress by Mr. H. M. Hobart. This paper deals mainly with the little-investigated subject of the inductance and reactance of coils in a direct-current dynamo armature. The reactance of such coils is of importance when considered with reference to the phenomena of commutation. The experimental data upon which the paper relies for the determination of armature-coil inductances appear to be somewhat meagre, and an excellent field here exists for experimental measurements. The general conclusion is arrived at, however, that the reactance voltage of the coils under commutation in a direct-current dynamo should not exceed 3 or 4 volts. The specifications of three direct-current generators of 400, 800 and 1600 kw capacity are carefully tabulated, and in these the calculated reactance voltage is from 2.8 to 3.9 volts. In these cases the flux density in the teeth is from 21 to 23 kilomaxwells, and in the air-gap from 9 to 10 kilomaxwells. It is quite reasonable to expect that the true limits of sparking in dynamos depends among other quantities upon the reactance voltage. Moreover, it would seem that no accurate formula can be expected to express the sparking limits which does not take this reactance voltage into account.

Electric Power for the New York Central.

The directors of the New York Central Railroad issued the following statement on Wednesday of this week, of which we give the substance below:

The company now confirms the statements made from time to time in the public press that it has been preparing plans for changes in the methods of using the Park Avenue tunnel, so as to meet the demands of a constantly increasing traffic, and provide for the convenience of the traveling public. The best method of improvement, and one which the company desires, would be the abolition of the tunnel, and making in its place an open cut, similar to that south of Fifty-sixth Street, but this, on account of the opposition it has encountered, has been impossible of attainment up to the present time, and, therefore, after a thorough investigation of the subject, it was determined that the mos practicable plan for caring for the enormous passenger traffic concentrated in the Grand Central Station would be the construction of a loop station under the present terminal, so that the suburban trains could be operated by electricity through the existing side tunnels, to be equipped with the most modern appliances for underground traction, and to the accomplishment of this plan the efforts of the company have for some time past been directed. In this way the passenger facilities of the present station would be nearly doubled, and, with the suburban business thus provided for, the through passenger and mail business can be moved through the center tunnel with promptness and regularity, which is very important to the traveling public, the city and the railroad.

Before determining that electrical or some other power shall be substituted for steam on all trains entering the Grand Central Station, it must be demonstrated that the business can be safely and promptly handled in that way, therefore, it is contemplated to make the experiments in the side tunnels and the underground station.

To carry out its plan, it will be necessary for the company to obtain from the Legislature and the city authority to use power other than steam (to which it is now expressly limited by statute) and to obtain changes in Park Avenue, so as to give use of that street south of the tunnel, in order to lengthen the approach to the station, also the right to construct a tunnel underneath portions of Forty-third, Forty-fourth and Forty-fifth streets, Park, Vanderbilt and Depew avenues.

These changes necessitate the purchase of a large amount of property in order to provide a new location for Park Avenue. Considerable of this property has already been acquired or contracted for, but more remains to be purchased, and this somewhat premature announcement of the company's intentions may make the accomplishment more difficult.

The company is prepared to proceed with the work substantially on the plan outlined above when the necessary legislation can be obtained.

Electrical Engineers of the Day—XXIX.

Edward P. Burch.

Edward P. Burch was born in Wisconsin in 1870, and obtained his early education in the public schools at Menomonie, Wis. He began to show marked interest in physics and electricity while in the High School, and after graduating therefrom in 1887 he entered the University of Minnesota. Two summer vacations were spent in active electrical work as a wireman, and later as a draughtsman with the Chicago Edison Company, which practical work operated advantageously to supplement his technical training. In 1891 Mr. Burch was appointed student instructor in electrical engineering at the university, under Professor F. S. Jones, now head of the department of physics in that institution. His graduating thesis at the University was on "Electric Railway Motor Tests," and embraced experimental tests of the now obsolete Sprague commutated field, the Thomson-Houston double and single reduction motors, the old barrel, rheostat and J controllers then in use in street railway systems; also running tests on cars in regular service on the interurban road between Minneapolis and St. Paul, and power house load diagram for 290 cars, all of which were then interesting. At the June, 1892, meeting of the American Institute of Electrical Engineers, a paper was presented in conjunction with Professor George D. Shepardson on the above subject.

After graduation Mr. Burch entered the service of the Twin City Rapid Transit Company, of Minneapolis and St. Paul, then, as now, owning and operating one of the largest electric railway systems in the country. During his more than seven years of service with this company, most important street railway progress took place. In 1892 he contributed largely to the development of a new series-parallel controller, which was used by the company until 1900, and worked on the re-design of the railway motors. He was appointed electrical engineer for the system in 1893. Soon after, he raised the voltage in the company's power station from 500 to 625 volts. He argued that by proper design the motors would have less repairs at the higher voltage, and this was found to be true. The change also prevented additional investment in feeders for a period of five years, during which the car mileage and station output increased 50 per cent. The introduction of a system for equalizing the potential on railway feeders, which he developed in 1894, is now in common use.

About this time Mr. Burch began the study in a most systematic way of power transmission. In 1895 he was engaged in laying plans for a central power station at St. Anthony Falls for the transit company's system, which would utilize water power, direct-connected units, with 3500 and 12,000 volts alternating-current three-phase transmission, in underground cables, and rotary converter sub-stations. This system, now becoming a standard for large railway systems, was put in full service three years later for the entire street railway system of Minneapolis and St. Paul, embracing some 250 miles of track. As early as 1898 six 600-kw railway rotary converters were in use. After having had charge of the operation of this

new system and of the 10,000-hp St. Anthony Falls water power station for two years, Mr. Burch resigned his position as electrical engineer for the company to engage in business for himself, but was retained as its consulting engineer. During his service with the company the construction and equipment of its heavy interurban lines were successfully carried through.

Since Jan. 1, 1900, Mr. Burch has acted as a consulting engineer, specializing on electric railways. Most of his work has been on interurban roads. He believes that street railway systems are not yet perfected, but that future development will be slow. That the perfection of the 100-mile interurban road is the work of the next few years, and that the electrical equipment of the steam roads will follow immediately thereafter. With this in view, his specialization and study have related to standard steam railroad practice and the electrical problems involved.

Mr. Burch has presented at colleges and before engineers' clubs numerous papers embracing such subjects as the economical cross section of railway feeders, an equalizer system for feeders, the synchronizing of alternators, and the utilization of water power for electric railway systems. His latest paper, "Electric Traction for Heavy Railway Service," has attracted much attention from steam railway engineers.

Mr. Burch is an active member of the American Institute of Electrical Engineers, and of the Northwest Railway Club, and is secretary of the Engineers' Club, of Minneapolis.

The Waterside Station of the New York Edison Company—III.

HIGH-TENSION FEEDERS AND SUBWAY SYSTEM.

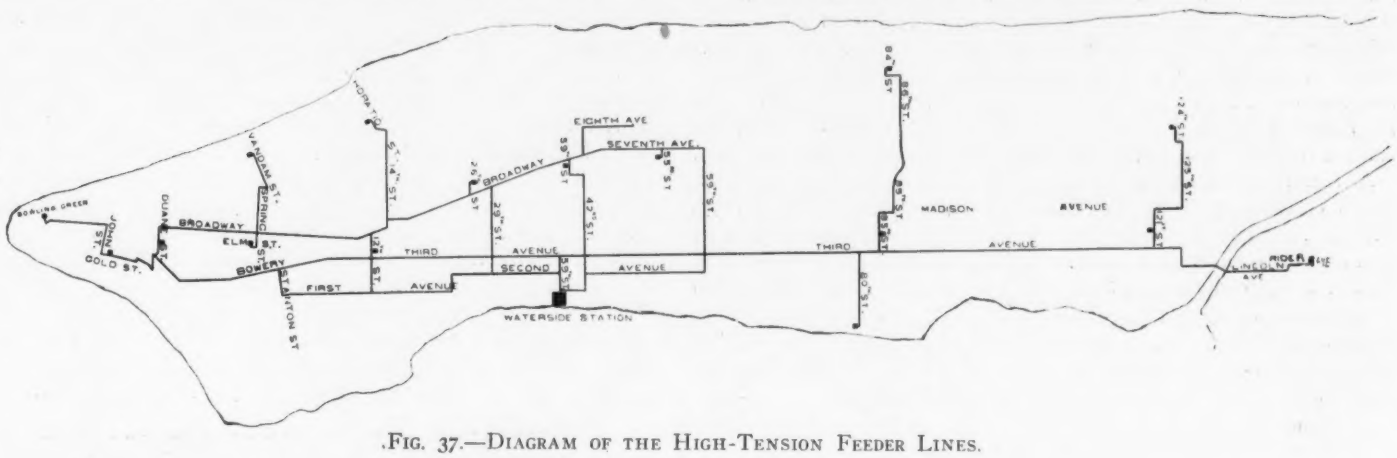


FIG. 37.—DIAGRAM OF THE HIGH-TENSION FEEDER LINES.

RESUMING our description of the New York Edison system and the new Waterside station, we come next to the high-tension feeders and subway system. The three-phase, 25-cycle current at 6600 volts generated at the Waterside station is distributed to the various rotary converter sub-stations by underground cable feeders, leaving the high-tension cable vaults at the Waterside station and following four distinct trunk lines of subway ducts, West on Thirty-eighth Street and on Thirty-ninth Street, and north and south on First Avenue. These main trunk lines make connection with the general subway system of the Consolidated Telegraph & Electrical Subway Company, at the intersection of the main avenues and with the east and west trunk lines on Twenty-ninth Street and Forty-second Street. The ducts of the Subway Company operating the high-tension subways cover practically all of the main avenues of the city, and many of the cross streets, and with the main and subsidiary connections represent a total length of about 1000 miles of duct. The ducts in which the cables are drawn are either made of iron pipe laid in concrete or glazed tile laid on a bed of concrete. Manholes are provided at street intersections and at intervals of 250 ft. to permit the drawing in and splicing of cables, with intermediate hand-holes in the distributing ducts for subsidiary connections to customers. In the manholes all cables are carefully racked and the manhole covers are ventilated to prevent accumulation of gas in the ducts and manholes. The Consolidated Subways, in addition to the high-tension cable of the New York Edison Company, are occupied by the cables for the lighting and power circuits for 60 cycle alternating current distribution and cables for the direct-current high-tension series arc light circuits. As a protection against mechanical injury and interference from other cables the high-tension, three-phase cables are protected in the manholes by a wrapping of asbestos and steel tape. In laying out the feeders for each sub-station, care was taken to have the feeders follow different subway routes so as to ensure continuity of service in case of trouble in a manhole. The size of the cables used for feeders has been selected to secure the best utilization of a 3-inch duct, the size generally used by the Subway Company. The number of feeders to each sub-station was based on the most economical copper section for the observed station load factors, the maximum drop not to exceed in any case 5 per cent, and the maximum carrying capacity for continuous load has been fixed at 250 amperes per phase. To fill these conditions the standard copper section was adopted of 250,000 cm. sectional area for each of the three conductors.

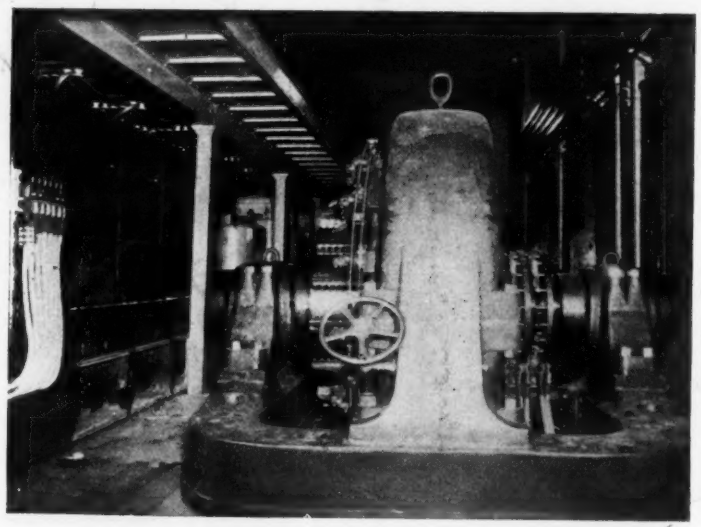


FIG. 38.—1000-KW WESTINGHOUSE ROTARY IN SUB-STATION.

The first three-phase high-tension, 6600-volt cables installed by the company in 1898 were rubber insulated, and this type was used in the early extensions, but in the more recent additions to the high-tension cable system, paper insulation has been used exclusively. The company is now operating about 41 miles of rubber insulated cables and 28 miles of paper insulated 6600-volt cables. The specifications for the high-tension feeder cables call for a 250,000 cm., three-conductor paper insulated, lead-covered cable, each conductor made of 37 strands of copper wire, with a combined sectional area of 250,000 cm., when each wire is laid out straight. The paper insulation is 5/32 inch around each conductor and 5/32 inch for the outside insulating jacket. The lead covering is 4/32 inch in thickness, and contains from 2 per cent to 3 per cent tin. The open spaces between conductors are filled with a dry jute filler, saturated with an insulating compound to exclude air or moisture. The test pressure between copper conductors and copper conductors and lead jacket is 15,000 volts alternating current for one hour, an insulating resistance in subways, including joints of 300 megohms per mile at 60 degs. F. The insulation resistance of each high-tension feeder is tested every week, as required by the rules of the Subway Company. In addition

to these periodic tests, electrostatic volt meters and ground detectors of the General Electric Company type are installed at the Waterside station, and at the several rotary converter sub-stations, furnishing instantaneous indication of any considerable lowering of the insulation of the system.

In Fig. 37 is shown a diagram of the present layout of high-tension feeders. The heavy lines representing the routes followed, the number of feeders in each route is not shown.

The general principle followed in planning high-tension feeders has been to run direct lines from the Waterside station to each sub-station, but in some cases feeders are looped into an intermedite sub-station along the route. In such cases the looped feeder is connected to a high-tension tie feeder panel provided with suitable connection so that the tie feeder may also, if desired, be connected to the local station feeder panels which feed the rotary converters at the station, thus providing an additional feeder in case of an emergency.

A feature of the high-tension feeder scheme is the general tie feeder connecting all stations and sub-stations from Duane to 124th Street. Along its route the general tie feeder is either looped in or teed in, to the sub-stations, and furnishes to them a valuable auxiliary feeder, which can be used to transmit high-tension current between sub-stations, independently of the Waterside station, as it has been extensively used in the past when inverted rotaries have been operated to supply current at night from the downtown steam generating stations to the rotary converter sub-stations uptown.

SUB-STATIONS.

The company has now in operation 16 rotary converter sub-stations on Manhattan Island, as shown on the map in Fig. 5. In several of these sub-stations the rotary converters are operated in connection with existing steam plants; in others rotary converters only are operated. In all of the latter, as well as in several of the former, there is one or more storage batteries, of which mention will be made later.

A brief description of the several stations will be given later, but to illustrate the character of service in the different districts, it may be stated that the section of the city below Eighth Street is exclusively a business section, and has the characteristic load curve of a day load rising abruptly in the morning hours before 9 A. M., and continuing with a practical uniform load until about 5 P. M., with the exception of a heavy dip at the noon time, when the motor load goes off the system and a sharp evening peak between 4.30 and 5.30 o'clock in the winter months, when the motor and lighting loads overlap. After 5.30 o'clock the load falls off very abruptly to a small fraction of the peak load. The district between Eighth Street and Fifty-ninth Street is largely of a commercial character, and including retail stores, hotels, theaters and clubs, as well as some residences. The section above Fifty-ninth Street is essentially of a residential character, with a load curve having a peak lasting from 3 to 4 hours.

The three city districts so described are for operating convenience, classified as the first, second and third district, respectively. The development of the company's business has progressed from the first district to the uptown districts in regular succession, and while at the present time the New York Edison direct-current, low-tension mains do not extend above 130th Street, the company is continually extending its territory northward to meet the rapid development of the city in the northern section of Manhattan Island. Fig. 37 shows the location of all distributing stations of the New York Edison Company.

In the first district there are five low-tension distributing stations —in the second district seven (including Waterside), and in the third district four (exclusive of the Eightieth Street station, which generates high-tension current only).

North of the Harlem River the Rider Avenue station supplies the Borough of the Bronx with two-phase alternating current and direct-current series arcs. This station is connected with a high-tension three-phase circuit to the Waterside station and a high-tension transmission line connects with Riverdale and the Yonkers Electric Light Company.

Of the existing generating stations only the Duane, Twelfth and Twenty-sixth Street stations will be operated as combined steam and rotary sub-stations, their existing steam plants being utilized as generating stations supplementary to the Waterside station during the period of heavy loads in the winter months.

All the other stations will finally be exclusively rotary converter sub-stations. The arrangement of the rotary converters, as installed in conjunction with the original steam plant, had to conform with the existing conditions of the building and the uses for which it was originally designed. In the new sub-stations, however, the buildings have been designed with the most suitable arrangement for this particular service. The sub-stations of the company are built on one of three plans, shown in the full-page illustration (Fig. 41), of which the 83d Street and Elm Street stations represent the first type, Horatio Street, 84th Street, 121st Street and 124th Street the sec-

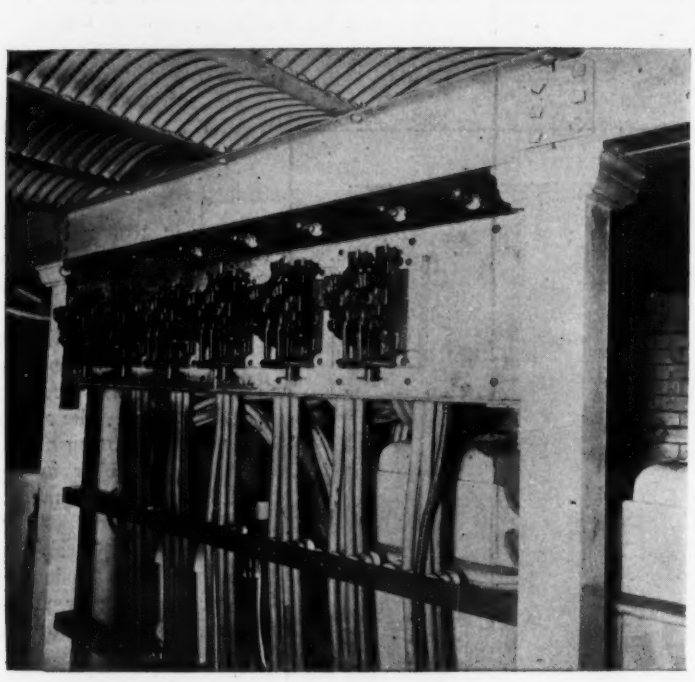


FIG. 39.—ELECTRICALLY OPERATED ALTERNATING-CURRENT SWITCHES.

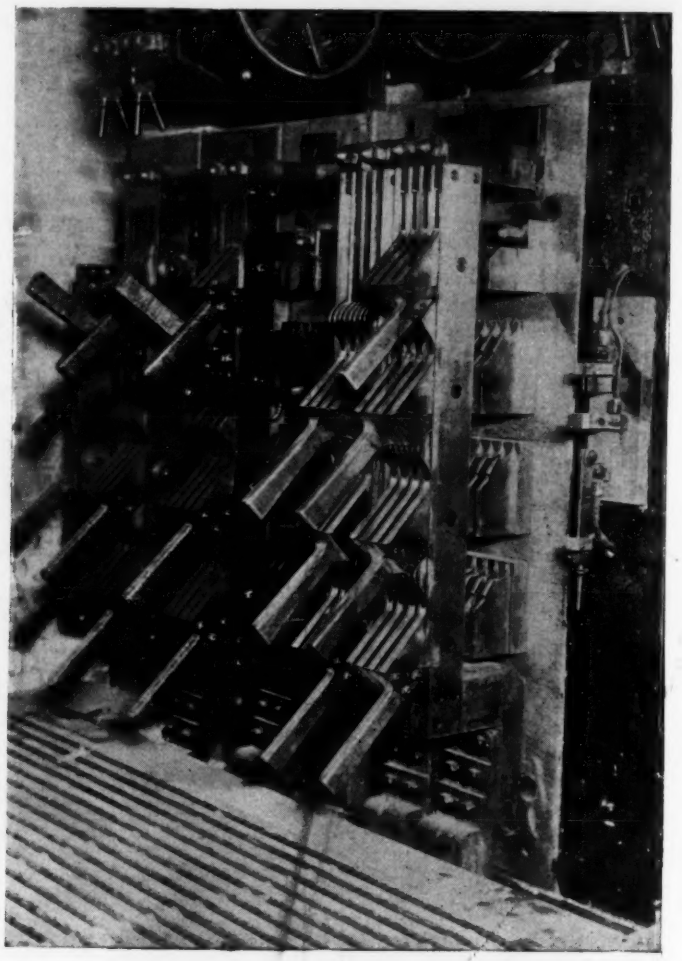


FIG. 40.—OUTSIDE POLE POSITIVE BUS SELECTOR SWITCH.

FIG. 41.—THE NEW YORK EDISON COMPANY'S SUB-STATIONS.

1.—E. 83d Street Sub-Station. 2.—W. 26th Street Annex. 3.—W. 84th Street Sub-Station. 4.—500-kw G. E. Rotary. 5.—Group of Three 200-kw Transformers and Regulator Platform. 6.—High Tension Feeder Panels. 7.—Low Tension Positive Switchboard. 8.—End Cell Switches and Battery Room.

ond, and the Twenty-sixth Street rotary converter annex—occupied also by the company's local offices—the latest type. In the sub-stations of the first group the ground floor is the main operating room containing the rotary converters and static transformers. The high-tension feeder panels and the high-tension rotary converter panels are mounted on a gallery at the height of the first mezzanine floor and running lengthwise the whole length of the station above the static transformers. The floor above the operating room is occupied by a storage battery, and above this again are two sets of comfortable and well-equipped living apartments, occupied by men of the company's operating force.

In the plan of the second type of sub-station the main floor, raised slightly above the ground, constitutes the operating room, but the

1. High-tension switchboard for high-tension feeders and rotary converter machine panels.
2. Air-blast static transformers.
3. Low-tension, alternating-current switchboard for the operating of rotary converters.
4. Rotary converter I. R. T. regulators.
5. Rotary converters.
6. Low-tension direct-current switchboard and busses, with instruments and synchronizers.
7. Storage battery and booster set.
8. Compensator for balancing loads on three-wire system.
9. Low-tension feeder panels.

In Fig. 42 is given a diagram of the connection of this apparatus.

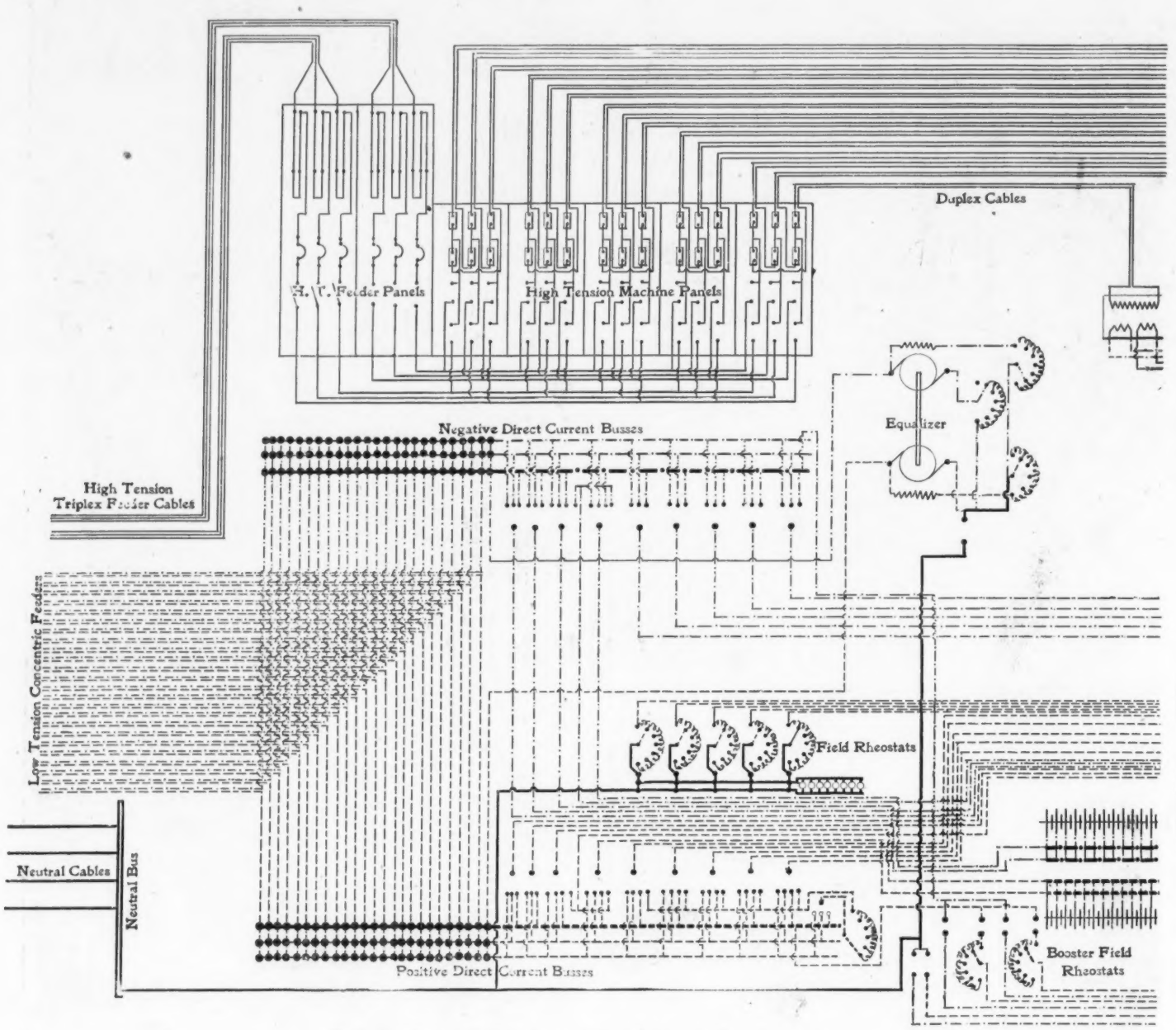


FIG. 42.—GENERAL DIAGRAM OF SUB-STATION CONNECTIONS.

low-tension rotary and feeder switchboard is placed lengthwise on both side of the station on the front of the main floor and the high-tension apparatus is mounted on the mezzanine floor. In some of these stations the battery is on the floor above the operating room, in others the battery is located in the basement, the top floor being used for living apartments by members of the operating force.

In the new Twenty-sixth Street annex all the rotary equipment is erected in the basement of the building, and the low-tension and high-tension switchboards are located on the two mezzanine floors in the rear of the building. The floor above is occupied by the company's offices for the second district.

The typical equipment of a rotary converter sub-station is:

The course of the current through one of the sub-stations is as follows: Coming into the station on the high-tension, three-conductor cable feeder as 3-phase, 6600-volt, 25-cycle alternating current, it passes through the high-tension feeder panels equipped with suitable switches, circuit breakers and transfer cable arrangements, with connections to the busses of the high-tension machine panels. From the high-tension machine panels connections are made by duplex cables to the high-tension primaries of the static transformers, the secondaries are connected through alternating current switches to an I. R. T. regulator and then to the alternating current collector rings of the rotary converter. The direct-current terminals of the rotary converter are wired to the positive and negative switches of the ma-

chine, which can be connected to three sets of bus-bars supplying current to the low-tension direct-current feeders. The rotary converters are all built for a normal potential of 270 volts, which can be raised or lowered 30 volts by the I. R. T. regulators, and the unbalancing of the station load between the two sides of the system is supplied by the storage battery and a compensator.

HIGH-TENSION PANELS.

The three-conductor high-tension feeder cables are brought from the subway ducts to the high-tension gallery and the feeder ends spliced and equipped with cable terminals are connected to the high-tension feeder panel equipped with single blade quick break snap switches mounted on marble slabs and insulated by porcelain insulators and bushings. Receptacles and jumpers located above are used to make connections between different high-tension feeder

STATIC TRANSFORMERS.

The static transformers are all of the air blast type and are in sets of 3-200 and 3-400 kilowatts respectively for 500 and 1000-kw rotary converters. They are mounted on a platform constituting the air duct for ventilation under an air pressure of ½ to ¾ ounce supplied by electric blowers installed at one or both ends of the platform. The primary and secondary transformers are wound for a ratio of transformation of 6300 to 170 volts, but other ratios may be obtained by connecting to intermediate taps to compensate for drop on feeders of different lengths and to facilitate adjustment of A. C. voltage to D. C. voltage required. In the later transformers a thermometer is mounted in a casing between transformer coils to give temperature indications. The transformers are designed to operate at 25 per cent. overload for 3 hours after a 24 hours' full load run,

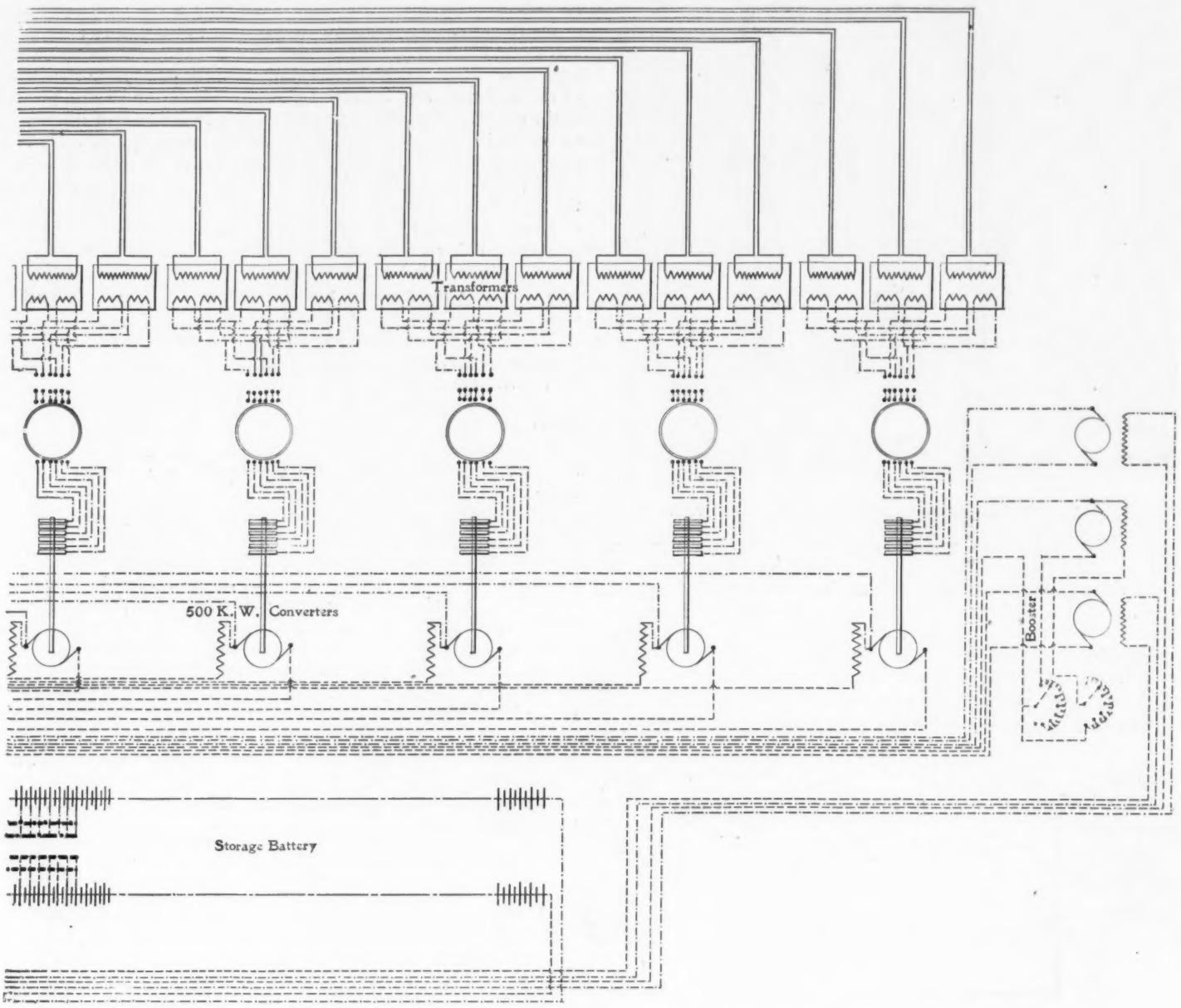


FIG. 42a.—GENERAL DIAGRAM OF SUB-STATION CONNECTIONS.

panels by means of plugs and transfer cables. A set of expulsion air circuit breakers are located at the top, and a set of reverse current relays, overload and time limit relays at the bottom of the panels. The series and potential transformers for the instruments and relays are mounted on the back of the panel. The machine panels are furnished with two sets of bus-bars and a double set of knife blade bus-selector switches, enabling each machine to be connected to either bus-bar, each fed by a high-tension feeder, as above explained. The high-tension machine panels have two sets of knife blade, quick-break bus-selector switches with barriers and six fuse blocks of the expulsion type. The high-tension panels were supplied by the General Electric Company.

or 50 per cent. overload for 1 one hour without undue heating. The efficiency of the transformers is 97½ per cent for the 200-kw transformer and 98 per cent for the 400-kw, with a regulation of 1¼ per cent and 1 per cent. They are wound with double secondary winding, connected in a double independent delta, the middle points of which are connected to the A. C. electrically operated switches. The static transformers were furnished by the General Electric Company and by the Westinghouse Company.

LOW-TENSION A. C. SWITCHBOARDS.

The use of electrically-operated switches mounted on the transformer platforms and controlled by small S. P. S. T. switches on

the operating board, results in shortening of cables as well as space on the operating switchboard. Fig. 39 gives a view of a set of E. O. switches. On the same panels are also mounted synchronizing and pilot lamps used as indicators.

I. R. T. REGULATORS.

The secondaries of the induction regulators are connected in series between the E. O. switches and the A. C. collector rings of the

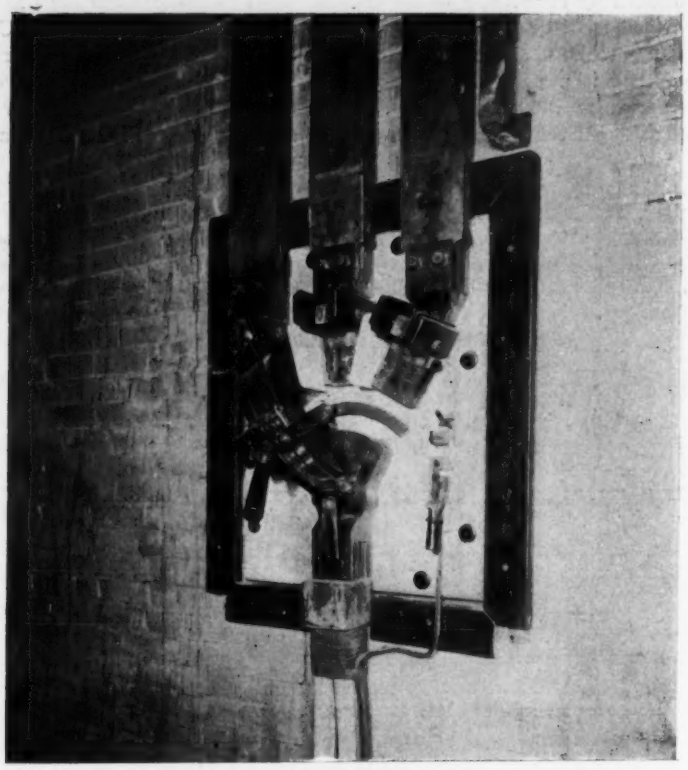


FIG. 43.—OUTSIDE POLE NEGATIVE BUS SELECTOR SWITCH.

rotary. The potential or primary windings of the regulators are connected across the secondaries. The primary windings are wound on the rotor of the regulator, which can be turned through a fixed angle in either direction by a small D. C. motor or induction motor controlled from the operating switchboard. The I. R. T. regulators of General Electric and Westinghouse make have 65-kw capacity for 500-kw rotaries and 130-kw capacity for the 1000-kw rotaries. These regulators are of the air blast type and are installed on the same platform with the static transformers, as shown in Cut 5 of Fig. 41.

ROTARIES.

The rotaries are six-phase and of two sizes, 1000 and 500 kilowatt rated capacity. The 1000-kw rotaries are 270-volt D.C., 187½ r.p.m.; the

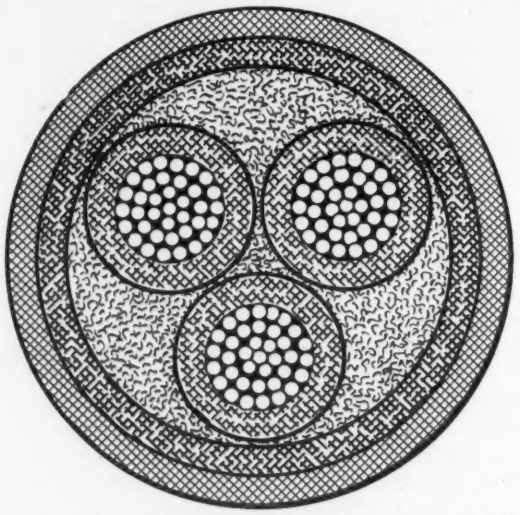


FIG. 44.—SECTION OF THREE-PHASE HIGH-TENSION CABLE.

500-kw rotaries are either six-phase, 270 volts D. C., 375 r. p. m., or six-phase, 300 volts D. C., 375 r. p. m. The latter type are equipped with 130-kw I. R. T. regulators, by means of which the rotary can be operated between the range of 240 to 360-volt D. C., the higher voltage being required in the uptown sub-stations owing to the length of L. T. feeders. The overload capacity of the rotaries is liberal, they are designed to carry 25 per cent overload for three hours after carrying continuously full rated load or 50 per cent overload for one hour.

The efficiency of the rotary converters is high. In the case of 1000-kw converters an efficiency of 96¾ per cent, and in the 500-kw 95¾ per cent has been obtained. The rotary converters were supplied by the General Electric Company and the Westinghouse Company.

THE L. T. D. C. SWITCHBOARD.

The D. C. switchboards of all New York Edison stations are divided into two independent sections for the positive and negative poles, the negative side being used for connecting the machines to the busses. The regulation and switching is usually done from the positive switchboard which is provided with a complete equipment of instruments. The negative switches used as selectors have three poles, one for each set of bus-bars. To economize space and avoid long runs of cables in some sub-stations, three-pole selector switches of the laminated toggle Brush type are used, having an arm pivoted at the center, and having a parallel motion to the base of the switch, as shown in Fig. 43. In other sub-stations the negative cable connections of the rotary converters are brought to the negative switchboard proper, where they make connection to a three-pole switch of the type shown in Fig. 40, where three switches, mounted on a heavy cast copper frame, alive from the machine, enable one to make connection to either of the three bus-bars on the back of the switchboard. These switches are only 12 inches, or 18 inches wide, respectively, for the 500 and 1000-kw rotaries, and reduce the width of the negative machine panel to a minimum.

An outside pole field switch, mounted on the same panel with the negative bus-selector switch, connects to the main bus from which all rotaries are excited.

The switchboard connections of the positive side of the rotary converter are made to a three-pole selector switch similar to the one last described and shown in Fig. 40. In this case, however, there are four switches mounted, the top one being a smaller starting switch for starting the rotary from the D. C. side.

This switch makes connection with a starting bus provided with a starting rheostat and fuse, and a three-bus starting selector switch mounted at one end of the switchboard. Above the machine bus-selector switch is mounted a double dial rheostat frame holding edgewise rheostat dials for two rotary converters. On the same frame are mounted two small S. P. S. T. switches operating the E. O. switches on the A. C. panels previously described, and a small double pole double throw switch operating the motor controlling the position of the I. R. T. regulator. Above the rheostat dials are the indicating instruments, consisting of one A. C. hot wire round type Stanley ammeter, one synchronizing lamp, one direct-current Van Vleck edgewise Weston ammeter and one hot wire alternating-current Stanley voltmeter for each station, this latter instrument being supplied with a sliding contact switch, by means of which it can be connected to any machine.

Wireless Telegraphy.

In a lecture recently delivered before the Royal Institution, London, Professor Fleming considered Marconi's recent Newfoundland experiments with reference to the curvature of the earth. He said that Marconi's transatlantic waves were about 1000 ft. long, which was not very small compared with the obstacles they had to encounter; that is, the hill of water formed by the curvature of the earth, which he calculated was about 110 miles above a straight line joining the Lizard and Newfoundland. The bending required, therefore, was not great compared with the distance, being comparable to a wave one-hundredth of an inch in length bending round an obstacle one-fifth of an inch high. It is an interesting question whether it was conceivably possible to send an electric wave around the world. He did not presume to answer the question, but he suggested that it was an interesting possibility. He had already shown that water is opaque to the Hertzian waves, and he believed it likely that the upper strata of air, being highly rarefied, were also opaque to these waves. He imagined that by internal reflection between these two opacities a beam of rays could always, as it were, be confined between them, and so, provided the impulse was strong enough, it could be made to pass any distance sandwiched between them independently of the curvature of the earth.

Electrical Equipment of the Manhattan Elevated Railway — II.

LAST week a formal run was made with the first train, equipped with the General Electric train control system, and consisting of six cars. These six-car trains will be run during rush hours in place of the five-car trains, thus increasing the carrying capacity of these lines at the rush hours 20 per cent. Each six-car train will consist of four motor cars and two trailers, each of the four motor cars being equipped with two motors of General Electric manufacture, which will easily develop, when starting the train, 300 horse-power, the total weight of motors for each train being 35,000 lbs. and the total horse-power per train 1200. One thousand eight hundred of the new motors have been ordered, aggregating in weight about 75,000 tons and 270,000 horse-power. These motors take the place of about 300 locomotives. A distinguished party participated in the trip and visited the power plant, going from the road to it in New York Electric Transportation stages. In our next issue we shall discuss the train equipment.

The current generated in the central power plant is to be distributed over the entire system of the Manhattan Railway, including 37 miles of road in the Boroughs of Manhattan and the Bronx. The potential at which it leaves the power plant is 11,000 volts, and eight sub-stations have been erected at convenient points along the lines of the road where transforming apparatus is installed to reduce the voltage to proper pressure for use in connection with rotary converters. The uniformity of plans and methods in the Manhattan system is especially noticeable in the sub-stations. The general arrangement of these and the distribution of apparatus are similar, thus enabling an operator familiar with one station to perform duty at another when required without any special training. Fig. 2 is an interior view of sub-station No. 7, located at Third Avenue and Ninety-ninth Street.

The switching arrangements in the sub-stations are similar to those in the power house. An idea of this arrangement may be obtained from Fig. 3, though this actually represents a section of a power-house board. The similar sub-station board is flanked on each side by direct-current panels, and the illustration shows only the alternating current panels and the feeder bench board. On a panel rising above the back of the bench-board are located the alternating-current instruments. Each rotary has an incoming wattmeter with a scale reading up to 300 kilowatts, a power factor meter and a wattmeter, all of which instruments are of the end-on type. On the bench-board there is for each incoming feeder and rotary converter a controlling switch with visual signals, the signals being operated automatically on the face of the bench-board. By manipulating these dummy switches, and by means of a low-tension direct-current controlling circuit, the main switches are operated, and the visual signals indicate the completion of an operation and the state of the circuit.

FIG. 2.—SECOND AVENUE LINE, SHOWING THIRD RAIL.

The rotary converters are arranged in two parallel rows, and the transformers are located in groups of three upon galleries along the sides. There are 26 rotaries and 78 transformers in these eight sub-stations. Each rotary receives current from a group of three 550-kw step-down transformers, connected in delta, at a potential approximately 390 volts. The sub-stations are located at unequal distances from the power station, and as all of the stations are to be supplied with power from alternators operated in parallel, the effective potentials delivered by the high-potential distributing cables to the several sub-stations will differ. In order that the potential of the direct-current delivered by the rotary converters shall be equal, provision for the adjustment of the ratio of transformation of the step-down transformers is made by means of loops brought out from the primary windings.

FIG. 1.—FIRST ELECTRIC TRAIN ON SECOND AVENUE LINE.

The transformers, one of which is shown in Fig. 7, are of the air-cooled Westinghouse type. Motor-driven blowers are installed in each sub-station for supplying the necessary air. The guaranteed efficiency of the transformers for full load is 97.75 per cent. The overload rating of the transformers is proportioned to those of the rotary converters.

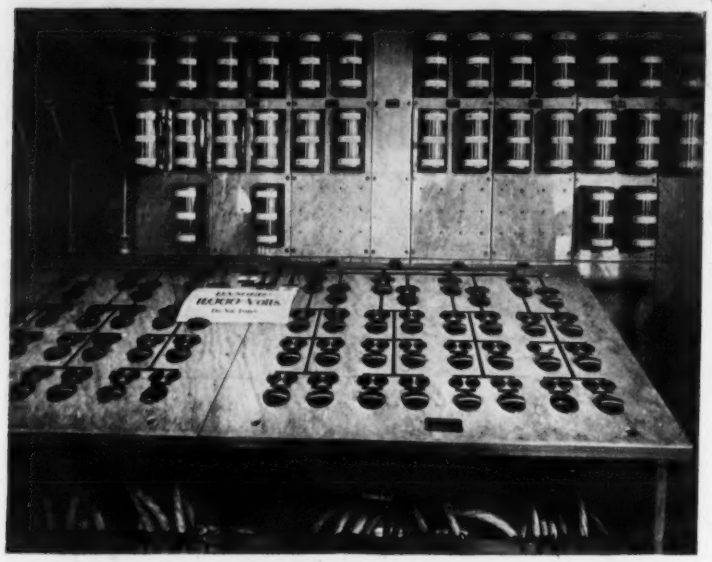


FIG. 3.—ALTERNATING CURRENT PANEL AND FEEDER BENCH BOARD.

The rotary converters, one of which is shown in Fig 4, are larger than any that have heretofore been constructed, having a nominal rating of 1500 kw and maximum capacity of 2250 kw, or 3000 hp. Each converter is a self-contained unit, the two bearings and the lower half of the field frame being mounted on a common base. The field frame is divided in a horizontal plane to permit access to the windings. The machine has 12 poles, and when supplied with an alternating current of 25 cycles per second will operate at a speed of 250 r. p. m The field is compound wound, the shunt winding being arranged for self-excitation. The output of the converter is delivered at a normal potential of 625 volts. The guaranteed efficiency at full load is 95.75 per cent. The armature is of the slotted

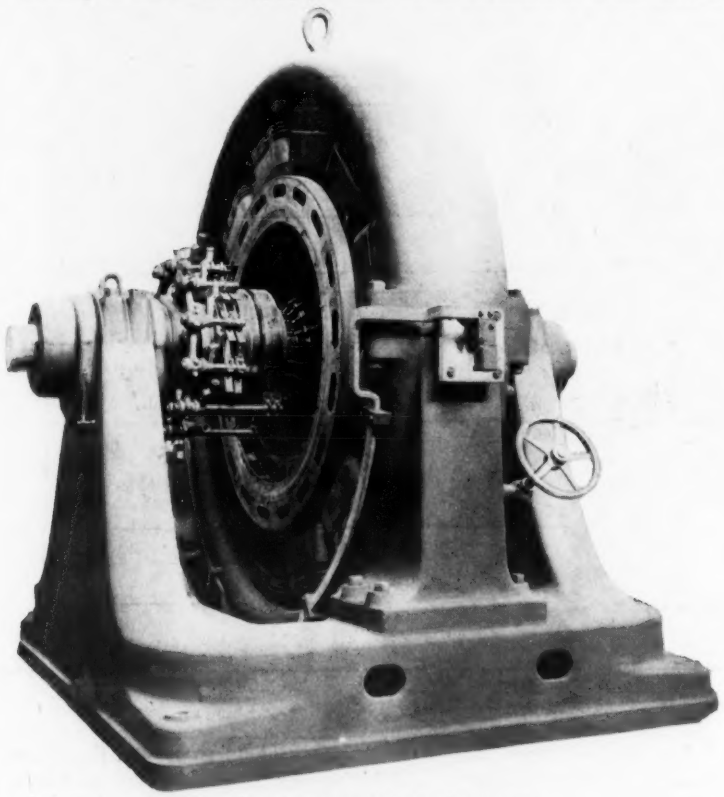


FIG. 4.—1500-KW ROTARY CONVERTER.

drum type, and the poles are built of laminated steel, forced upon a cast-iron spider. The armature winding consists of strap wound coils formed and insulated before being placed in the slots in which they are held by retaining wedges of hard fiber. The winding is of the parallel type, forming 12 circuits, and is cross-connected by balancing rings. The commutators are built of bars of hard copper insulated from each other with mica. The number of bars is such that with a potential of 625 volts across the direct-current terminals the average difference of potential between two bars will not exceed 12 volts. The copper brushes are held in brush-holders of the sliding-shunt type.

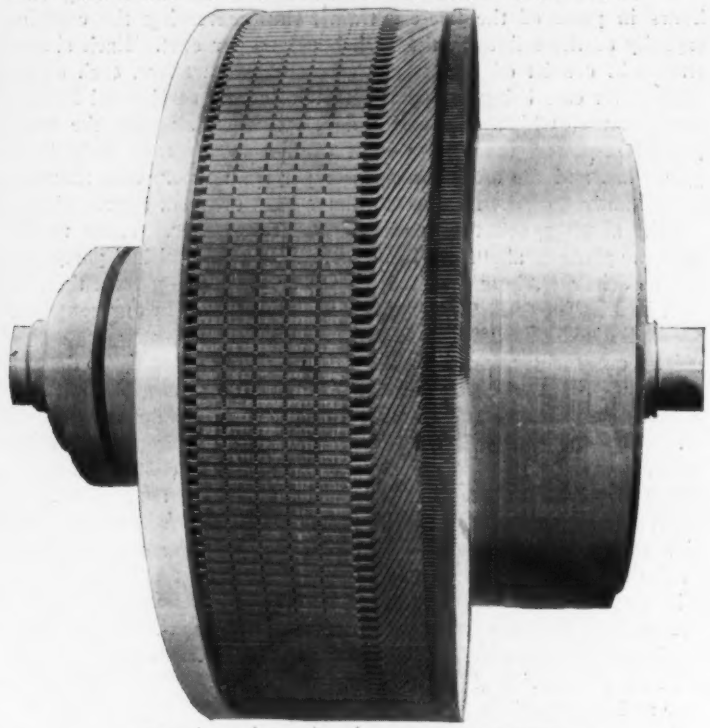


FIG. 5.—ARMATURE OF ROTARY CONVERTER.

The collector to which the alternating currents are delivered from the step-down transformers is of the open type, and is clearly shown, together with other features of this side of the machine in Fig. 4. The armature is shown in Fig. 5.

The field frame is of cast iron, and the pole pieces are of laminated steel. The faces of the latter are beveled at the edges to permit of the use of copper shields. The series field is designed to assist the shunt as the load comes on the rotary converter, and is sufficient to compound the latter from 575 volts at no load to 625 volts full load. The series winding consists of copper, strap-wound on edges. The wave form of these converters is practically the same as that of the alternators. The converters are guaranteed to stand an overload of 100 per cent without "hunting," and may be overloaded to several times the normal full load without falling out of step. In the construction of these converters the flywheel effect has been made relatively small, and the effect of the copper shields powerful enough to have the controlling effect upon the armatures of the converters. The total weight of each converter is 105,000 lbs., the height 13½ ft., and the floor space occupied 13 ft. by 10 ft.

The converters are started by direct current. A motor-generator set (Fig. 6) is installed in each sub-station for furnishing the current for that purpose. The method of starting by direct current derived from these starting sets, rather than by direct current taken

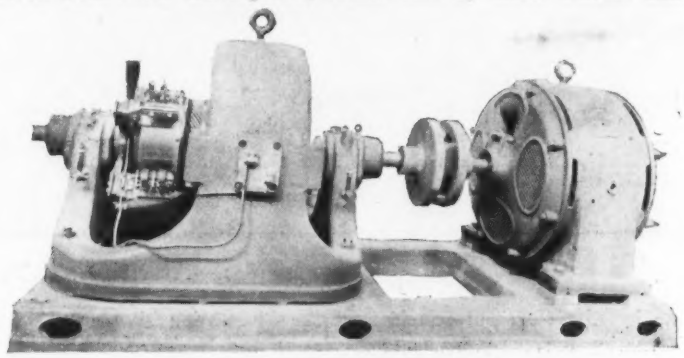


FIG. 6.—MOTOR-GENERATOR.

from the main bus-bars of the sub-station, was determined upon to avoid undue magnetic and electrical strains in the converter, such as may easily result from a slight mistake of the operator, for example, in closing the synchronizing switches when the machines are not exactly in step.

The plans of the Manhattan Company provide for handling 200,000,000 passengers during the next year, and the new form of equipment will enable them to put on many more cars and run their trains oftener and at higher speed than could be done with steam locomotives. Another advantage is in eliminating smoke, dirt, cinders and the noise that are always attendant upon the operating of steam engines. Moreover, the company will enjoy many advantages, not the least of which will be the increased economy in operating expenses.

With the new equipment it is estimated that 2,000,000 passengers can be carried in a day. This represents the movement of over two hundred trains daily, requirnig an expenditure of energy varying from 5000 hp at the hours of minimum load to 60,000 hp, at the hours of maximum load.

To the engineer and the railroad expert the electrical equipment of the Manhattan Railway presents many points for consideration and study. The magnitude of the undertaking and the character of the work performed cannot fail to command universal attention. The fact that the conservative Manhattan management had sufficient confidence in the electrical equipment to substitute it for steam locomotives upon all its lines indicates a marked change in the attitude of the company toward electricity. This change of itself is convincing proof that great advancement has been made, and that the Manhattan management believes that electrical engineering for heavy railroad work has at last passed the experimental stage. In this position it has been fully sustained. The equipment of the immense power station at Seventy-fourth Street has been accomplished without the least friction or drawback, and the great generators, although

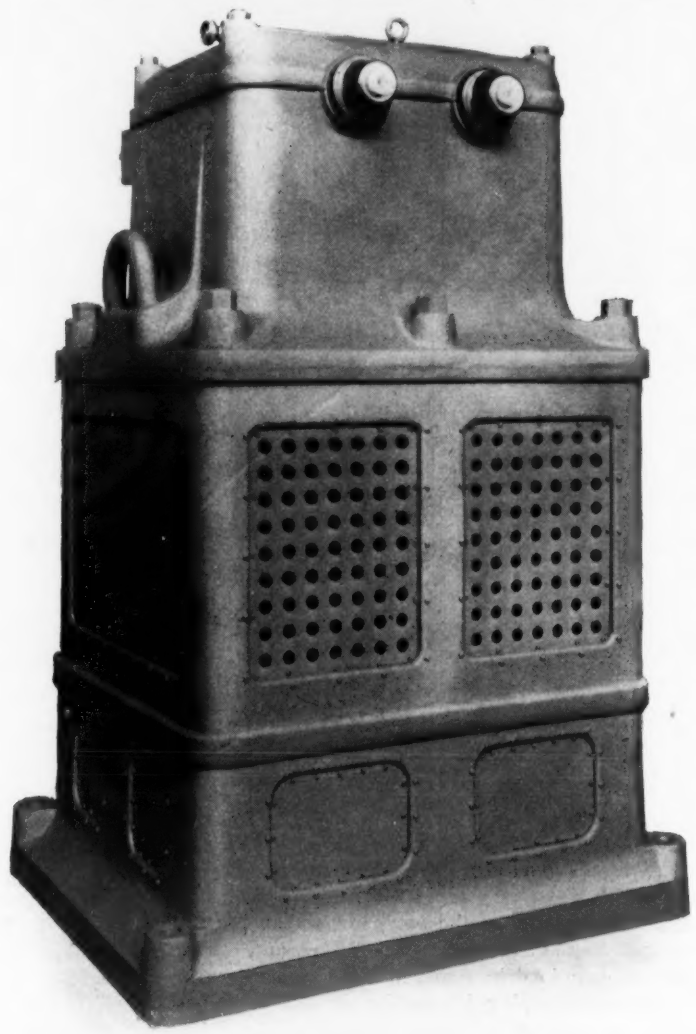


FIG. 7.—550-KW TRANSFORMER.

the first of such magnitude ever attempted, were assembled, erected and operated without the slightest hitch, and immediately pressed into commercial service. The designing and building of these machines, it may be added, marks an important and distinctive advancement in electrical engineering, as did the construction of the original Niagara generators made by the same manufacturing company.

Some Pointers on Induction Motors.

BY DR. LOUIS BELL.

AT the present time the induction motor needs no defence of its general properties, for it has amply proved its capabilities. To a certain extent, however, it does need to be saved from its friends, and brought to the point where the public will look at it as at any other motor and not regard it as in any way a freak surcharged with occult properties. The writer has always rather "had it in for" the rotary pole treatment of the induction motor, not because it did not substantially represent the facts, but merely by reason of its putting a very unfamiliar face on a motor that is strictly comparable with other motors.

The man who uses an electric motor does not worry himself over the permeability of the iron, the magnetic density in the armature teeth or the specific inductive capacity of the insulation. On the contrary, he does not want to be bored with such technical details, but much desires a good, strong, efficient machine that will do his work well and steadily with a minimum of attention and expense. Such a machine he can find in the induction motor when polyphase current is available, but the average man does not know it in this simple fashion, and judges induction motors by canons that are altogether inscrutable. In the early days of induction motors there was, I am sorry to say, a tendency on the part of many of those who sold them to throw a veil of mystery about them, and to convey the idea that some mysterious hocus-pocus in virtue of a magnetic field whisking around like a kitten chasing her tail, induction motors would do strange and wonderful things in an occult and incomprehensible fashion. Like most false impressions, this has eventually led to trouble, and the development of induction motors has thereby suffered.

For example, take the question of starting current, an objection so often raised to induction motors. No rational man would expect to put an ordinary 110-volt, 10-hp shunt motor in his shop and then start it successfully by simply closing the main switch. He realizes perfectly well that he would probably blow the fuses or possibly burn out the motor, and, at all events, would get a tremendous current through it, and, so like a rational being, he puts in a starting box. But if an induction motor is in question he eyes it suspiciously, and hints that he understands that it takes an enormous starting current, and will knock out his lights when it is thrown on. If an auto converter is suggested as a means of easy starting, he intimates that it is a pretty mean sort of a motor that compels him to buy and operate that thing, and that if induction motors were any good they would not require it. A starting resistance in the armature circuit he regards as a thing of evil put there to make the best of a bad matter. The last thing that occurs to him is that if a motor did not permit a considerable rush of current when thrown on the circuit at full voltage, it would be a very bad motor indeed as regards efficiency. I have sometimes threatened to make and publish the current curve of a shunt motor trying to start under a load at full voltage, merely to impress this fundamental fact.

In the matter of variation of speed under load the case against popular superstitions is even more amusing. One of the commonest demands on the part of users of induction motors, and smart little engineers who have learned the equations of the rotary field, is that an induction motor shall hold its speed within, say, 1½ per cent from no load to full load. Now, this is not an impossible requirement, and has many times been met, but what would happen if a demand were made for a continuous current motor to fill this specification? The proposition would either be met by a more or less blunt refusal to supply the thing or by a price for special design that would be hair-raising. Moreover, such a requirement is in most cases simply foolish, inasmuch as only very rarely is such a regulation of the slightest importance. It can be provided more easily in an induction motor than in any other, but it always implies an extraordinary effort to get as much copper as possible upon the armature even at the expense of considerable inconvenience elsewhere. The customer may imagine that with such a specification he will obtain a motor of phenomenal efficiency, since in both shunt and induction motors the fall in speed under load measures the loss in the armature; but unless price is no object he may rest assured that when a motor for any kind of current is fattened with respect to one property it will be pinched in others, and he will get about what he is willing to pay for, and no more. In point of fact, no requirement placed upon a designer produces more trouble and expense with a less valuable result to show

for it than a very close speed regulation. Hence while the induction motor actually can give wonderful results in this direction, extreme requirements hinder the production of good standard all-round machines at a moderate cost, and should never be made unless actually needed.

Another common exhibition of ignorance is in a demand for motors of extraordinarily low speed. Whatever the character of the motor, low speeds means a larger and costlier motor than would serve at higher speed, and induction motors form no exception to the rule. In fact, they are somewhat more troublesome to design for very low speed than are continuous current motors, since they require an exaggerated multipolar construction that makes it hard to retain a good power factor. In certain cases low-speed motors are highly desirable, but they should not be specified to carry out some fine-drawn theory, or for the fun of the thing, unless one is willing to pay for them.

If one looks over the list of standard motors for continuous currents as produced by any manufacturer he will very quickly perceive, by an examination of dimensions and weights, that a low-speed motor is generally merely the next larger size of standard speed motor differently wound. In the case of induction motors such an arrangement is not feasible, and the result is unusually an extreme multipolar design that demands a phenomenally small air-gap if the power factor is to be kept up. The only thoroughly bad induction motors, which the writer has ever of late years examined have been machines hoo-dood, so to speak, by the attempt to get abnormally low speeds in comparatively small motors. A similar attempt in continuous-current motors leads to costly machines of low efficiency, but for some occult reason the average man swallows a low, real efficiency in continuous-current motors without making any fuss, but kicks like a mule at low apparent efficiency in an indication motor.

A high-power factor is very desirable in an induction motor, and should be helped and not hindered whenever possible. Within reasonable limits it is comparatively easy to obtain unless some extraordinary demand for unusual properties in other respects comes in the way. But it is as a matter of design interconnected with all the other features of the motor, and can be crowded out if pushed too hard.

In some respects induction motor design is easy. The absence of the commutator and the elimination of all questions of sparking is an enormous advantage in modifying the machine to suit various requirements, but all design is a series of compromises, and when the property is exaggerated some of the others are necessarily curtailed.

When a freak specification calls for a 10-hp motor of 360 r. p. m. at 60 cycles, to vary 2 per cent in speed between no load and a 50 per cent overload, and to have a power factor of not less than .90 at full load, the designer has his work cut out for him, and if he comes anywhere near to filling the requirements, the resulting motor will not be one, the building of which should be encouraged in point of quality or price.

The loudest objection raised against induction motors at the present time is their cost. Built as they are of piles of high-grade laminated iron, they need all that can be gained by the abolition of the commutator, and the simplification of the armature windings to come out even with continuous-current machines, particularly since their field winding is difficult.

But the largest factor in keeping up their price to-day is neither material nor intrinsic labor cost, nor monopoly, but the inherent foolishness of those who continually howl for all sorts of outrageous special designs—designs which imply great added expense. Special machines are sometimes necessary, and can be readily obtained in induction motors, as elsewhere, but I know of no branch of electrical industry that has been so infected by a mania for freaks.

Ordinary continuous-current motors have settled down into fairly regular lines of manufacture, and when anything far outside these lines is required it can be obtained, but as a special machine at a considerably increased cost. The same is true in general machine production. One can buy standard lathes, for example, to meet all ordinary requirements at reasonable prices. But if some long-haired and fussy old personage insists on having one a little different from anything that the mind of man has yet devised, he must have a long bank account. I have had occasion from time to time to get many quotations on special work, and I am bound to say that electrical manufacturers in general make less fuss about it and add less cost than those in most other lines.

For the good of the art special machines should be used only when they confer some really material advantage. It is hard to see why the demand for alternating motors should be more diverse than that for continuous-current motors, but it certainly happens to be, and while this condition remains manufacture cannot settle down to the steady lines that ensure low art of production. Users of motors, and engineers as well, ought to realize that specialization is cheap only on a very large scale, that is, when special and regular work merge into each other. And in induction motors this condition is far from being realized, hence the average costs are undeniably high when judged by comparison with standardized continuous-current motors.

Stereoscopic Rontgen Ray Pictures.

By Frank C. Perkins.

THE interesting Röntgen ray stereoscopic system of Mr. E. W. Caldwell, described in your issue of Dec. 21, is an indication of the great progress made in recent years in stereoscopic methods for locating foreign substances buried in the tissues of bodies, and a review of some of these methods may be of interest.

In an article in the *Electrical Engineer*, in 1896, Professor Elihu Thomson pointed out the desirability of the stereoscopic method in Röntgen ray surgical examinations. M. Chabaud described an apparatus for stereoscopic radiography in a paper read before the Societe Francaise de Physique in 1898, whereby a foreign substance

FIG. I.—RÖNTGEN RAY PICTURE.

may be located in the human body, and its distance from any given point of the skeleton definitely determined. He employs a vacuum tube which gives very rapid records, and utilizes a stand which enables the operator to take two radiographs of the same object from two different but precisely defined foci, and then after development they are examined in a special stereoscopic apparatus.

The accompanying illustration is one of a pair of stereoscopic radiographs taken by Dr. G. P. Girdwood, of McGill College, and consulting surgeon to the Montreal general hospital. It will be noted that not only the bones are shown to perfection, but the skin as well. The pair of prints must be viewed with a reflecting stereoscope, as devised by Wheatstone and described in "The Scientific Papers of Sir Charles Wheatstone," published by the Physical Society of London. This apparatus can be made by putting two mirrors at right angles, as shown in Fig. 2, and then holding the pictures upright and facing each mirror, the observer's nose being at the angle of the two mirrors; then by looking straight into the two mirrors

one picture will be seen with each eye, and if they are correctly placed the hand will be seen as it was taken, with the back to the observer. If, however, the right eye picture is put before the left eye and the left eye picture before the right, the appearance will be as if looking from the other side.

Until recently it was extremely difficult to locate exactly metallic substances, such as bullets, needles, etc., in the hand, foot or other parts of the body, the relative depth being particularly hard to determine. The only evidence at hand was the sharpness of the

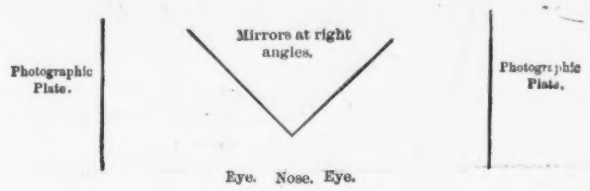


FIG. 2.—ARRANGEMENT OF APPARATUS.

shadow. The sharper the outline of the shadow the nearer the object was supposed to be to the surface, but this was not very satisfactory. By taking the intersection of lines from two radiographs taken at right angles, better results were obtained, but it was not absolutely certain that the rays which eminated from the tube terminal were in direct lines at right angles to one another. Cross lines have also been used above the part to be radiographed, the shadows of the wires at right angles indicating the relative position of the foreign substance. In taking the pictures the tube is moved a distance of 2½ inches to the right or left of the original position between the taking of the two radiographs, the subject remaining in the same place. The tube terminal is placed in each case so that a normal from the surface would strike the same spot; the pictures will then present exactly the same differences as the images in the two eyes, the result being a true stereoscopic effect, every part of the picture being seen in proper relation to surrounding objects. Following is a description of the method by Dr. Girdwood:

"In carrying out this idea, a piece of lead was fastened with a little gum on the back of the left hand over the metacarpal bone of the index finger. A second piece was placed and fastened also with gummed paper in the palm of the same hand opposite to the metacarpal bone of the ring finger, and the palm placed down on a plate wrapped in yellow paper in the usual way. The plate was put in the bottom of a cardboard box without a lid, and with a slit cut in one side large enough to admit the wrist, a line of pencil marked on the wrist, so as to put the hand back in the same position and a pencil outline of the hand made on the yellow paper around the fingers. Then a plumb bob was suspended over the center of the hand, and the Crookes tube arranged so that the center of the platinum plate should be 1¼ inches to the right of the pendulum string, and 12 inches from the plate, and the tube was rotated in the clip until a normal from the platinum distributor should strike in the same point as the point of the pendulum bob. With the pendulum moved out of the way and one picture taken, another plate was placed in the same yellow paper, the pendulum bob replaced, and the tube so arranged that the center of the platinum plate was 1¼ inches to the left of the plumb bob line, and so inclined that the normal thereto would strike the same spot as before, and a second picture taken. The pictures developed in the usual way gave two full size, indeed, slightly magnified skiagraphs of my left hand, and when cut in pieces small enough to mount as stereoscopic pictures at once gave the true stereoscopic effect."

Dr. James Mackenzie Davidson gave an account in a British publication of his process for making stereoscopic radiographs, which differs from that of Dr. Girdwood, in not having the normals of the platinum distributor in the ray tube converge in the two positions. These are taken as though seen with two eyes, whose axes are parallel instead of converging on a point 12 inches distant, representing the appearance presented to each eye, when the axis of vision is convergent.

Dr. Davidson used the Wheatstone stereoscope for combining the stereoscopic pictures to get the perspective effect. He also produced stereoscopic effects with the stereopticon, two of these pictures being projected by the lantern alternately upon the screen, with great rapidity, an operating shutter being used by the observer, which permitted only one eye to see the screen at a time. The pictures were in this way made to stand out in bold relief, showing depth and the true space relations of the objects. He also produced a stereo-fluoroscopic apparatus, using a stationary fluorescent screen, having two sight holes and an operating shutter, together with two Röntgen ray tubes, and one or two induction coils. When the apparatus was arranged with a single induction coil, a motor-driven switch was used to alternately excite first one and then the other tube, the shutter operating synchronously with the excitation of the two Röntgen ray tubes.

The interesting Caldwell stereo-fluoroscopic system differs from the above in employing a small double-focus tube having anticathodes separated by 2½ or 3 inches. The fluoroscope has an alternating-current induction-motor driven rotating shutter, which is operated by current from a rotary reversing interrupter, which breaks the current and reverses its direction through the coil twice in every revolution. A small rotary converter is used operating on a direct-current lighting circuit, and delivers two-phase or three-phase alternating currents from its collector rings for operating the shutter.

The fluoroscope shutter may also be operated on an alternating lighting circuit of 60 periods, in which case a speed of 1200 revolutions is obtained, and there are six times this number of shadows on the fluorescent screen, or 7200, one-half of which are seen by one eye and the other half, or 3600 shadow pictures, by the other eye, which practically is continuous vision. The object is thus brought out in relief.

The first stereoscopic radiographs were undoubtedly made by Elihu Thomson in 1896, and he has stated that at this time a number of such pictures were mounted for use with the stereoscope, for locating the position of bones in fractures with entire success.

The Debt of Electrical Engineering to C. E. L. Brown—VII.

BY B. A. BEHREND.

WE call attention to Figs. 36, 37 and 38, representing, respectively, Brown's stations at Petersburg, Russia, at Milan, Italy, and his Kander station, the latter supplying current to the Burgdorf-Thun three-phase railway.

A very beautiful type of revolving field generator is represented by

FIG. 36.—ST. PETERSBURG SINGLE-PHASE GENERATING STATION.

Fig. 39, which shows a drawing of one of the five high-tension generators in the Schwyz station. Like the Waedensweil generators, they have a very high surface speed, and they must be capable of giving their full output on a single-phase circuit. They are three-phase generators running at 400 revolutions, giving 8000 volts, and 46 amperes single-phase, and 33.2 amperes three-phase at 40 cycles. This makes them 460-kw generators. They were designed in 1896.

Their performance curves are given in Fig. 40. The rise in volt-

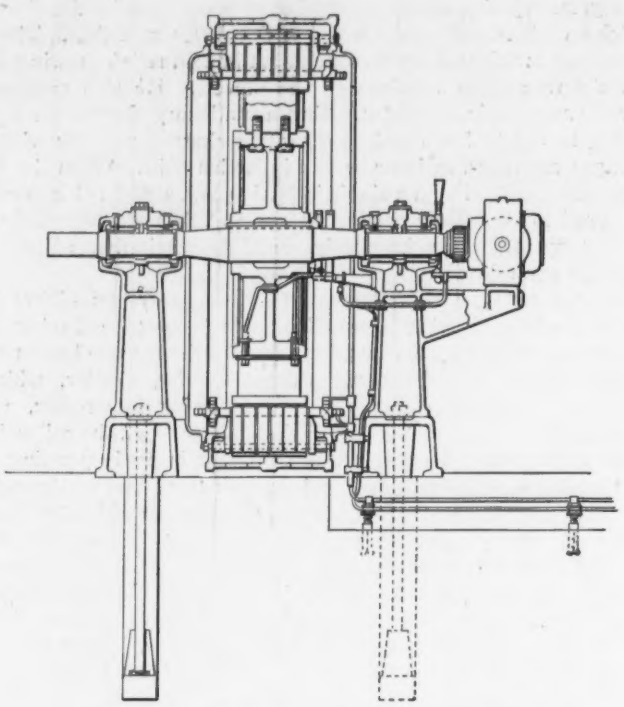


FIG. 39.—SCHWYZ THREE-PHASE GENERATOR.

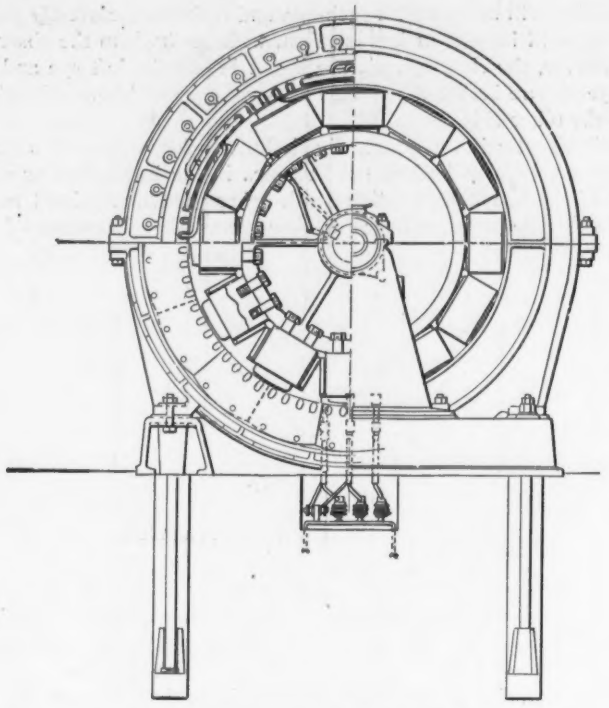


FIG. 39*a*.—SCHWYZ THREE-PHASE GENERATOR.

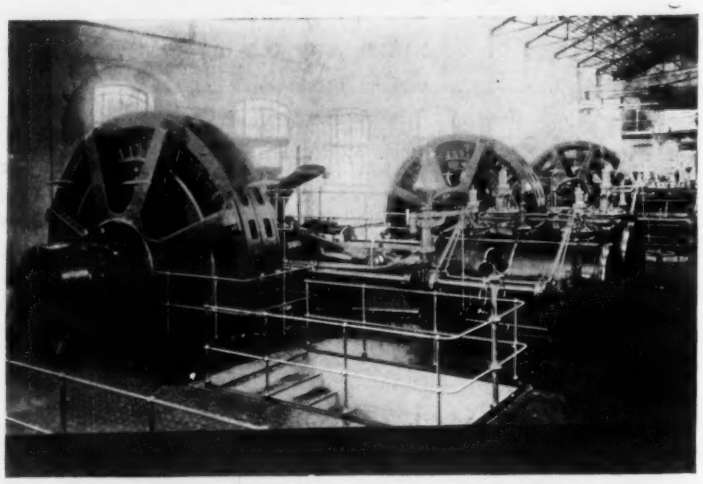


FIG. 37.—MILAN THREE-PHASE GENERATING STATION, PORTA VOLTA.

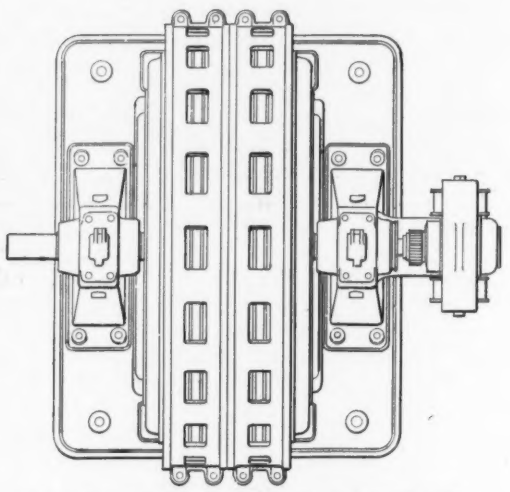


FIG. 39*b*.—SCHWYZ THREE-PHASE GENERATOR.

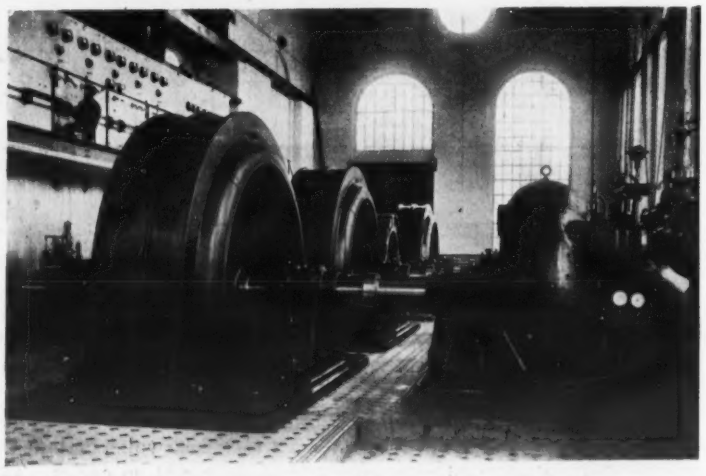


FIG. 38.—KANDER GENERATING STATION.

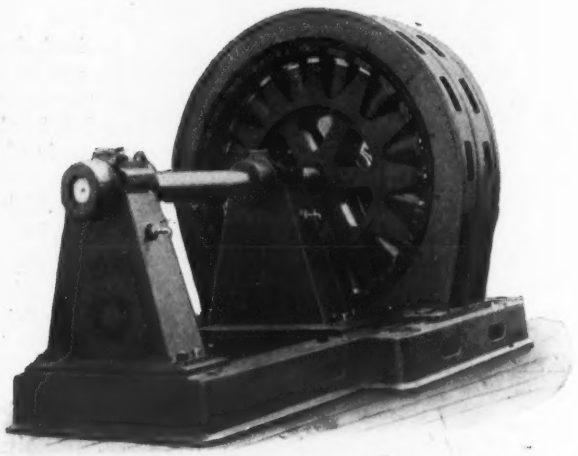


FIG. 41.—REVOLVING FIELD GENERATOR WITH ALTERNATELY-WOUND POLES.

age on a single-phase circuit for 46 amperes of power factor 100 per cent is 600 volts, or 7½ per cent. On a three-phase circuit, if a load of 33.2 amperes is thrown off, power factor 80 per cent, the rise in voltage amounts to 13.7 per cent.

The performance curves here published clearly show that Mr. Brown had worked his generators for the past ten years slightly beyond the bend of the saturation curve, but it is a peculiar psychological fact that men, when they understand an important principle for the first time, only too often imagine that nobody else had known anything about it before, and that the principle must be as new to others as it was to them.

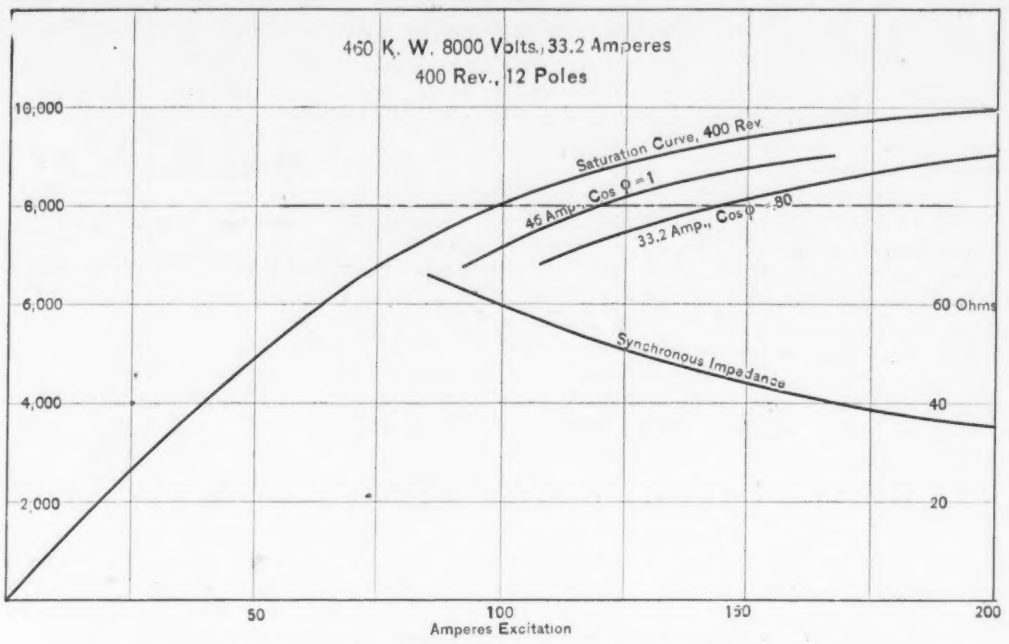


FIG. 40.—PERFORMANCE CURVES OF SCHWYZ GENERATORS.

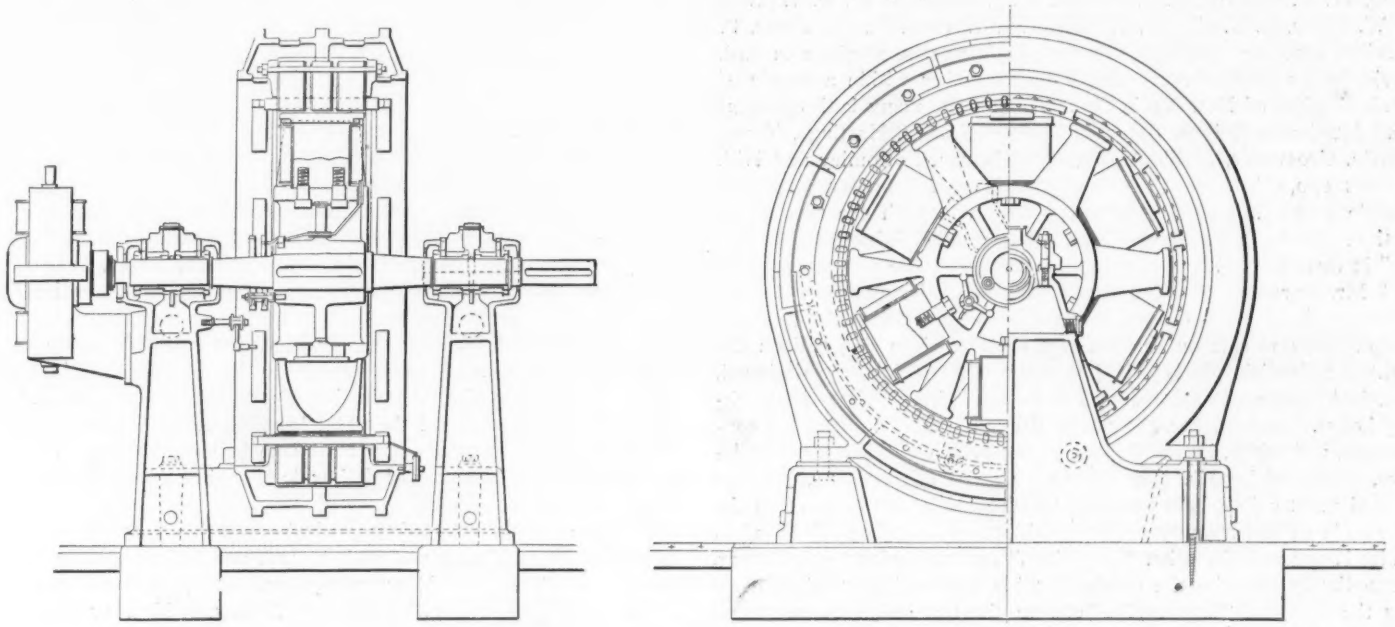
An interesting type of generator is represented in Figs. 41 and 42. Every other pole has an exciting coil. This construction permits the use of round steel poles even for small diameters. It has been copied in Europe by some prominent engineers, which fact may be considered a testimony to its usefulness. The rating of this machine is 130 amperes, at 1200 volts, and 40 cycles and 400 revolutions. The bore of the armature is 129 cm., and the length of the core 34 cm. There are six oval-shaped holes per pole, of which four are wound. The shape of the segments is of interest, as the equal inside and outside curvatures reduce the scrap not immaterially by simplifying the die work, and permitting the use of shears.

Municipal and Government Ownership in Canada.

There are signs of a growing popularity in the Dominion of the proposition of public ownership and control of public utilities, and particularly may this be said of telegraphs, telephones and electric lighting, writes a Canadian correspondent. During the recent civic elections held throughout Oontario, it is to be noted as a sign of the times that Ottawa voted to own and operate its own telephone service, and another city its electric lighting. Another feature in this respect is the apparent trend of public sentiment in favor of public ownership and control of submarine cables and land telegraphs.

Sir Sandford Fleming, of Ottawa, who has been foremost in the all-British Pacific cable project ever since its inception, is now actively promoting the establishment of two very important schemes: First, the desirability of a state-owned cable across the Atlantic, and, secondly, the transfer to the Canadian Post Office Department of the land telegraphs of the Dominion. The contention in favor of the latter proposition is backed by the fact that, since 1870, every part of the British Empire, except Canada, has nationalized its telegraph service. It may be pointed out in this connection that the Dominion Government has had under consideration, for a year or more, the important project of establishing a government postal telegraph system, to be operated by the post office department, as in England. It is quite likely that at the approaching session of the Dominion Parliament, Mr. Mulock, Postmaster General of Canada, will bring forward a bill to enable this policy to be carried into practical effect.

With regard to the proposed Atlantic cable, Sir Sanford Fleming claims that a state-owned cable is necessary over this ocean in order to complete the all-British telegraph line from Australia to England. The cost of such a cable is estimated at about $2,000,000, and the interest, sinking fund, cost of operating and maintenance, would amount to $166,000 a year. It is calculated that the cable would have a capacity of 10,000,000 words a year. At the extremely low rate of 2 cents per word, this amount of business would be sufficient to pay all working and other charges. The rate at present suggested, however, is 5 cents per word for ordinary messages and 25 cents for urgent ones.



FIGS. 42 AND 42*a*.—REVOLVING FIELD GENERATOR WITH ALTERNATELY-WOUND POLES.

The Institute Annual Dinner and Mr. Marconi.

The annual dinner of the American Institute of Electrical Engineers was held at the Waldorf-Astoria, in the Astor Gallery, on Monday evening, Jan. 13, when Mr. G. Marconi was the guest of honor. The affair had to be arranged at virtually forty-eight hours' notice, owing to the unavoidable uncertainty of Mr. Marconi's departure from Canada, and his intention of sailing almost immediately from New York after arrival here. In spite of this shortness of time in which to issue notice to the members and make all the necessary preliminary arrangements, the dinner must be pronounced a brilliant, and even remarkable, success. It was attended by over 300 members and ladies, including the foremost men in the profession, and the hard working dinner committee, which knew little of sleep between Saturday and Monday, had the gratification of seeing every one of its hasty plans and preparations crowned with success. The dinner committee consisted of Messrs. Calvin W. Rice, chairman; T. C. Martin, toastmaster; Dr. S. Sheldon, C. A. Terry, and C. O. Mailloux, who were also assisted greatly by Messrs. R. T. Lozier, J. W. Lieb, Max Osterberg, and, of course, Secretary R. W. Pope, all of whom worked like automobiles to carry out the arrangements. The Astor Gallery was set out with quartette and octette tables, and along one wall under a huge American flag ran a long table upon a dais at which were seated President Steinmetz, Prof. Elihu Thomson, Prof. A. G. Bell, Sir Percy Sanderson, C. B., British Consul General; Cav. Branchi, Italian Consul General; Dr. M. I. Pupin, Prof. F. B. Crocker, Frank J. Sprague, Wm. Stanley, C. W. Price, Carl Hering, Arthur Williams, president New York Electrical Society, and the toastmaster. Among the gathering also were Messrs. C. W. Hunt and Oberlin Smith, past presidents of the American Society of Mechanical Engineers; General Griffin and Mr. E. W. Rice, of the General Electric Company; Messrs. Murray and Brady, of the New York Edison Company; Messrs. Platt, Cuttriss and Clapperton, of the Commercial Cable Company; Messrs. W. H. Baker and F. W. Jones, of the Postal Telegraph Company; Messrs. Mallory, Upton and Hill, of the Edison Laboratory; Mr. J. C. Bayles, scientific editor, *New York Times;* Mr. Julian Ralph, the famous war correspondent, now of the *Mail and Express;* Messrs. Betts, Eugene Lewis and Ewing, of the legal profession; Messrs. D. McFarlan Moore, J. M. Wakeman, C. T. Child, J. F. McElroy; Peter Cooper Hewitt; Gano S. Dunn, Captain S. Reber, U. S. N., representing also General Nelson A. Miles; John Bottomley, T. D. Lockwood, W. D. Sargent, A. L. Rohrer, W. J. Hammer, W. D. Weaver, H. W. Blake, O. T. Crosby, W. Maver, J. Wetzler, M. Osterberg, P. Torchio, etc., etc. In fact, the company's names, if given in full, would be a roster of every well-known member within a couple of hundred miles of New York City. Among the many ladies present were Mesdames Edison, Sprague, Sheldon, Lozier, Hastings, Terry, Martin, Grosvenor, Mailloux, Blake, Wakeman, Bottomley and Hill.

The menu, printed in Italian olive ink on sea foam green card, bore outside a sketch representing an ocean scene, with the two coasts of the Atlantic, and a Marconi staff on two tall lighthouses signaling "ss" in three dots all the way across. In the middle was a medallion with Mr. Marconi's portrait, draped with the Italian flag; above it the Italian national coat of arms, and below it as a pendant the Institute badge. At one side on the left was the American flag and on the right the English. It is stated that the whole thing was designed, sketched, engraved, printed and delivered within thirty-six working hours. Around the room, the Elblight system of flexible conductors, and tablet, into which lamps can be stuck in any form or device, was used by Mr. Spaulding with great effect. On the tables twined great coils of the conductor with small green lamps. At the two ends of the room were large tablets, one reading "Poldhu" in white lamps and the other "St. Johns," in letters about a foot long. Immediately opposite the speaker's table was a similar tablet bearing the name of "Marconi." Between the three signs were strung strands of the conductor, into which were inserted clusters of three lamps at frequent intervals, to represent the three dots, or "s," sent across the Atlantic from the Cornish coast to Newfoundland. At fitting times these were flashed or allowed to stay illuminated, and the success was great. Another feature was the procession of waiters bringing in the ice creams which were incandescent lamps and electric vehicles grouped around wireless telegraph poles, and poles with snapped wires, between which came ships at sea—all in ice—suggestive in a way of the chilly reception that met Mr. Marconi at St. Johns recently. It is needless to say that these *tours de force* were quite heartily applauded.

President Steinmetz greeted the gathering after dinner was over and expressed his pride in the occasion and the success of the annual dinner, extending a cordial welcome to Mr. Marconi. He then turned the conduct of affairs over to the toastmaster, who read the following communications.

To T. C. MARTIN:

I am sorry that I am prevented from attending your annual dinner to-night, especially as I should like to pay my respects to Marconi, the young man who had the monumental audacity to attempt, and succeed in, jumping an electric wave clear across the Atlantic Ocean.

Yours,
(Signed) EDISON.

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46 and 48 East Houston Street,
NEW YORK, Jan. 13, 1902.

MR. CALVIN W. RICE,
American Institute of Electrical Engineers,
57 Duane Street, New York City.

Dear Mr. Rice.—Replying to your kind letter which was delivered during my absence from the city, I beg you to transmit to the Institute my thanks for the honor proffered.

I feel that I could not rise to the occasion, and regret not being able to contribute to the pleasure of the evening, but I wish to join the members in heartily congratulating Mr. Marconi on his brilliant results. He is a splendid worker, full of rare and subtle energies. May he prove to be one of those whose powers increase and whose mind feelers reach out farther with advancing years for the good of the world and honor of his country.

Yours very truly,
(Signed) N. TESLA.

NEWPORT, R. I., Jan. 13, 1902.

RALPH W. POPE,
Secretary American Institute of Electrical Engineers,
26 Cortlandt Street, New York.

I greatly regret my inability to attend the dinner to-night in honor of Mr. Marconi. It would afford me sincerest pleasure to give my evidence of my esteem and regard for him. I know him well enough to know that his genius is equaled by a modesty and reticence of statement for which I have an equal admiration with the first. When he told me last spring of his hopes I knew that he would do more than he mentioned. The result has more than justified expectancy.

(Signed) F. E. CHADWICK.
Captain U. S. N.

COLUMBIA UNIVERSITY.
PRESIDENT'S ROOM, Jan. 11, 1902.

MR. R. W. POPE,
Secretary of American Institute of Electrical Engineers,
26 Cortlandt Street, New York.

My Dear Sir.—I deeply regret that a previous engagement for the evening of Monday will deprive me of the pleasure of accepting the invitation that I have received through Professor Sever, to be present at the dinner tendered by the American Institute of Electrical Engineers to Signor Marconi.

I greatly regret my enforced absence, for I should enjoy being able to join in your tribute to respect to the distinguished inventor, and in felicitating him upon having placed his name on the roll of the great discoverers and the great benefactors of the human race; for there appears to be every reason to believe that the most important practical results will follow in due time from Signor Marconi's successful experiments.

Pray tender to your distinguished guest an expression of my sincerest congratulation and high regard, and believe me,

Very truly yours,
(Signed) NICHOLAS MURRAY BUTLER.

CITY OF NEW YORK,
OFFICE OF THE MAYOR.

January 13, 1902.

R. W. POPE, ESQ., 26 Cortlandt Street, New York.

Dear Sir: I am sorry that it is not in my power to attend the dinner of the American Institute of Electrical Engineers, to be given this evening, at which Mr. Marconi is to be the guest of honor. The results already obtained by Mr. Marconi mark him as a man who has been a benefactor of the race, and his latest achievement seems to give promise of still greater services to mankind. I wish it were

possible for me to be present, to say to him in person, on behalf of the city of New York, how highly his scientific labors are appreciated here. Asking you to convey to him my regards and best wishes, I am, Respectfully,

(Signed) SETH LOW, Mayor.

COMMERCIAL CABLE COMPANY OF AMERICA.
Geo. G. Ward, V. P. and Gen'l Mgr.
Executive Offices: Postal Telegraph Building, 253 Broadway.
NEW YORK, Jan. 13, 1902.

Dear Mr. Martin: Your letter of January 10th conveying the kind invitation of the American Institute of Electrical Engineers to dine with them on this, Monday evening, was delivered while I was away from the city. I regret to say that I am unable to accept the invitation. I am compelled to return to Washington this afternoon to attend to matters in connection with the Commercial Pacific Cable. I congratulate the Society on its distinguished guest. I am very sorry that I cannot be there to meet him.

Yours very truly,

(Signed) GEO. G. WARD.
(Local Sec. British Instn. Elec. Engs.)

WASHINGTON, D. C., Jan. 13, 1902.

CAVALIERE BRANCHI CONSUL GENERAL OF ITALY, NEW YORK CITY.

Sir: Absent because of previous engagements of importance from the dinner of the American Institute of Electrical Engineers given in honor of Signor Marconi, I beg you to offer my assurance that I am present in spirit and rejoice in the sympathy shown for our illustrious countryman, who adds his own to the other great Italian names of Volta, Galvani and Ferraris in the history of electrical science. The new invention of Signor Marconi, whose development will unite more and more firmly the new and the old world in all their relations, is really an inestimable victory of the human genius over the forces of nature, a noble conquest of civilization and mankind. I salute my glorious compatriot and thank the worthy and highly honorable Association which so fraternally welcomes and lauds him and his achievement.

ITALIAN AMBASSADOR TO THE UNITED STATES OF AMERICA.

Messages of fraternal felicitation were also read by Mr. John W. Lieb, to be sent to the foreign societies to which Mr. Marconi belongs.

The toastmaster then presented to the audience Mr. Marconi, who was received with three tremendous cheers.

Mr. Marconi acknowledged in graceful terms his appreciation of the warm reception he had received during the evening, and of his entertainment by such an eminent body as the American Institute of Electrical Engineers. It is, he said, well known all over the world that Americans stand first in applied electrical engineering, and he felt greatly honored to be in the midst of so many eminent men, whose names are household words in the whole civilized world.

Mr. Marconi then proceeded to give a brief description of what his system has at present accomplished, especially in reference to use on ships, and what he hoped it will accomplish in the future. Wireless telegraphy is now attracting very great attention all over the world, and its progress is not slow. Five years ago the system with which his name is identified was working over a distance of about two miles, but its range has been rapidly increased until a few months ago it was quite possible to communicate by means of an improved and attuned system over a distance of 200 miles. The commercial application of the system has been given serious consideration, and improvements have been made of importance. The commercial application of the system has been tried in Great Britain, its chief base being in England. There are now over 70 ships carrying permanent installations for wireless telegraphy. Of these 37 are in the British Navy, 12 in the Italian Navy, and the remainder are on the large liners, such as the Cunard Line, the North German Lloyd and the Beaver Line. There are over 20 stations in operation on land in Great Britain, and more are in course of construction.

Mr. Marconi regretted the impossibility in a brief address to go into the scientific details and the scientific development of his system, but he wished to correct some of the popular opinions which prevail as to the subject of wireless telegraphy.

It seems to be the general opinion, he said, that when a message is sent into space any one with a necessary apparatus can intercept that message and read it. Of course, this would be very awkward and would hurt the system from a commercial standpoint. No one would wish to have his private affairs made public in that way. For instance, stock quotations or other matters of secret could be found out. By experiments and improvements which have been made, messages can only be read when the receiver and the transmitter are attuned. This perfected system is not, however, at present in use on the ships. It has been deemed necessary that each ship should be equipped with apparatus which will permit of its reading a message sent from any other ship, because of the possibility of aid being required. Therefore, all ships are attuned so that one ship can call up any other ship, but it is practicable to have the apparatus so attuned that the messages transmitted can in no way be received by any other apparatus except that attuned to receive the message.

Mr. Marconi then quoted from Dr. Fleming as to some of his early experiments in syntonic telegraphy. Communication was established between Portland and Portsmouth, a distance of about 60 miles, with intervening hills of 800 ft. in height. Crossing these stations two other stations had been placed in operation, and it had been found that crossing messages did not in any way interfere with one another. Transmission of messages was also obtained between England and Ireland, two stations located a distance of 200 miles apart, and with the use of a very small amount of energy—about as much energy as is necessary to light a small incandescent lamp—messages were transmitted.

Taking up the subject of his most recent work, Mr. Marconi stated that the first experiments on transatlantic wireless telegraphy were to have been conducted between Cornwall, England, and Cape Cod, Mass. Just as the station at the latter place was being completed, however, it was badly damaged by a storm, and not wishing to defer the experiments, it was decided to make the trial with Newfoundland as a base, the shorter distance being also desirable, owing to the intention to install only a temporary station there. It was necessary here to use kites and balloons, which gave a great deal of trouble in getting them at the proper height, because of the wintry gales. But on December 12, for the first time, the kites were raised in a proper position, and signals were received from Cornwall at the right time, and at the pre-arranged speed.

Mr. Marconi said that experiments would have been continued, except for the bad weather conditions, and also the discovery of the fact that the Anglo-American Cable Company claimed to have the monopoly of all telegraphic communication in that colony—not only of all telegraphic communication, but of all experiments in any way connected with telegraphy. It claimed to have the right over the land and the sea. Mr. Marconi said these claims surprised him, and he contrasted the different treatment he received at the hands of the English Government. The British Government claims a monopoly of the telegraph, but encouraged his experiments more than prevented them. Certainly, when it comes to commercial work in establishing communication between the English coast and ships, an arrangement has been effected with Lloyds and suggestions have been made for future plans. He added that the manager of the cable station at St. John's was pleased that during the three days he was there they sent 50,000 words over the wire for the press.

Mr. Marconi then discussed the future of wireless telegraphy at length. He said he had not the slightest doubt that in the near future it would be possible to send many messages over the sea at the same time by instruments properly attuned. He said that he had been very greatly encouraged by the Government of Canada. It will be admitted, he thinks, that one of the greatest features of civilization in all the world is the facility with which people can communicate with each other, living long distances apart. His hope is that at no great distant date he shall bring his system to the point of perfection of allowing friends and relatives to communicate with each other across the ocean at a small expense. At present, by the existing cable system, the sending of messages across the seas is put out of the reach of people in moderate circumstances. The cost of laying the cables is so large that cable companies have to charge a high price for the service. Wireless telegraphy will cheapen the cost very greatly, and do away with all cables and the charge for their care.

In conclusion, Mr. Marconi said that he had built very largely on the work of others, and mentioned Clerk Maxwell, Lord Kelvin, Professor Henry and Professor Hertz. He referred to the fact that the message received at St. Johns was received through a telephone

receiver, and turning to its inventor on his right, added that with the telephone the name of Prof. Alexander Graham Bell is inseparable.

Prof. Elihu Thomson prefaced his remarks by saying that he had received the news of Marconi's great feat from over the telephone from a reporter, who wished to know whether he believed that signals had actually been received by Marconi across the Atlantic. Prof. Thomson asked the reporter if Marconi made such a statement, and upon being answered in the affirmative he said: "If Marconi says that he received the signals I believe they were received."

He paid a glowing tribute to Marconi for the great ability which he had shown in building up his system of wireless telegraphy, which was none the less remarkable because the system as a whole was founded upon fundamental principles discovered by others. While it was true that Hertz had been the first to demonstrate the waves upon which wireless telegraphy is based, yet the utilization of this discovery in such a practical manner was a great achievement and placed Mr. Marconi among the first inventors of the world. It has become a modern habit to make immediate use of new discoveries, and he referred to the rapid manner in which Röntgen rays had been utilized in surgery and now also in the cure of certain skin diseases, with a probability that the great discovery of Röntgen would still yield further benefit to man.

In the case of wireless telegraphy the leap was a remarkable one from a few hundred miles to Transatlantic telegraphy, and the utmost credit was due to the one who had made the bound. Prof. Thomson referred sarcastically to the action of the Anglo-American Cable Company in prohibiting further experiments in Newfoundland by Marconi, saying that the cable company was apparently not satisfied with a monopoly of the sea and the earth, but wished to extend it to the ether which extended throughout all space. Speaking of ether, he said it was a singular fact that while we had no knowledge of it as an entity, yet the great part of modern science was predicated upon its existence. Prof. Thomson concluded by prophesying a great future for wireless telegraphy.

The remarks of Prof. Pupin took rather the form of a lecture, being illustrated by a large number of charts. He first met some of the criticisms that had been made on Marconi's work, and referring to one which insinuated that the cables landing in Newfoundland had an influence on transmitting the signals from Cornwall, he said that it would be a greater feat to transmit through a cable the waves which influenced the receiving apparatus than it would to transmit them through the ether.

Referring to claims made that previous to Marconi wireless signals had been transmitted over short distances, he said that any schoolboy by means of an Hertzian oscillator could transmit such signals over a short distance, but that with this apparatus the limit was one mile. He considered that a phenomenon could be viewed from three standpoints—the mathematical, the physical and the engineering; and that while the work of the mathematician and physicist was undoubtedly of the highest importance, yet it required the engineer to make their work of avail to the world. He deprecated claims based upon general statements of what might be attained, and said that claims were only worthy of consideration as against work accomplished if they were accompanied by engineering specifications whereby any one could test them.

Prof. Pupin gave a lengthy exposition of the principles of wireless telegraphy, using as a first illustration an ordinary cable and then proceeding step by step until the Marconi system was reached. He showed that if in the middle of the submarine cable a condenser were placed, signaling would still be possible. If the condenser was increased in size and the distance between its plates and the diameter of the insulating sheathing correspondingly increased, another possible condition was reached, until finally the sheathing is increased to the size of the earth and the conductors merely entered each end. This he considered to be the ideal condition. The nearest approach to it was to consider that the surface of the earth corresponds to the sheathing, and the ærial conductors of Marconi to the conductor terminals. He said that this theory satisfies the telegraph circuit criterion laid down by Heaviside and explains very satisfactorily the Marconi system.

In conclusion, Dr. Pupin stated with emphasis that he did not consider wireless telegraphy would ever prove sufficient of a competitor to submarine telegraphy to endanger the present investments in that industry.

Cooper Hewitt Vapor Lamp.

We give herewith two views showing types of Cooper Hewitt vapor lamps that were exhibited at the recent meeting of the American Institute of Electrical Engineers. The photographs of the lamps

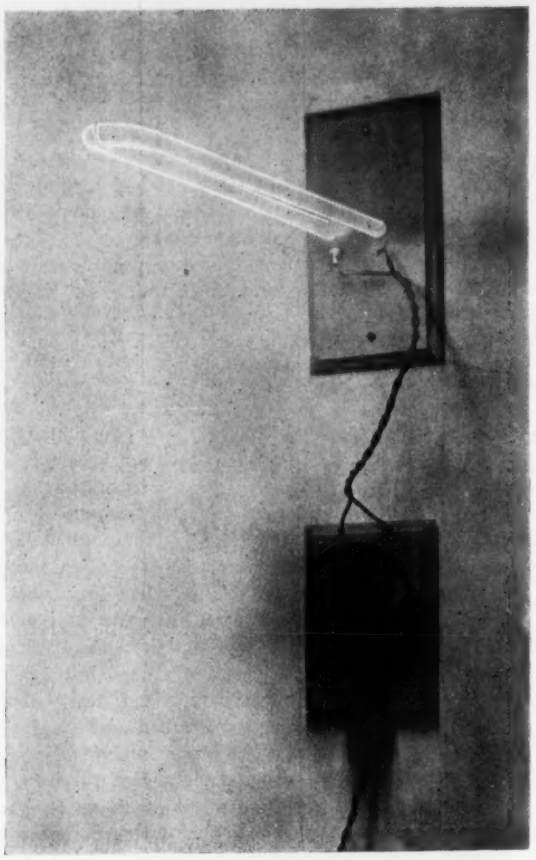


FIG. I.—HEWITT VAPOR LAMP.

were taken by the light of the lamps, which was then the only light in the room. The prints from which the engravings were made are poor, but the excellent character of the light for photographic purposes

FIG. 2.—HEWITT VAPOR LAMP.

may be surmised from the reproduction of an excellent photograph taken of President Steinmetz, which appeared in our issue of last week.

The candle-power of the horizontal type of lamp shown was 600.

With the starting device in the line the lamp took .5 watt per candle-power, and with the operating device out of circuit the consumption was less than .4 watt per candle-power. The lamp exhibited over the doorway was of 700 cp, and consumed .5 watt per candle, with the operating device in circuit, and .4 watt without. A lamp similar to these after being run 400 hours and again tested showed an economy of .35 watt per candle and no decrease in efficiency.

The device for putting the lamps in operation is shown in Fig. 3, which is one of a number of arrangements used by Mr. Hewitt and

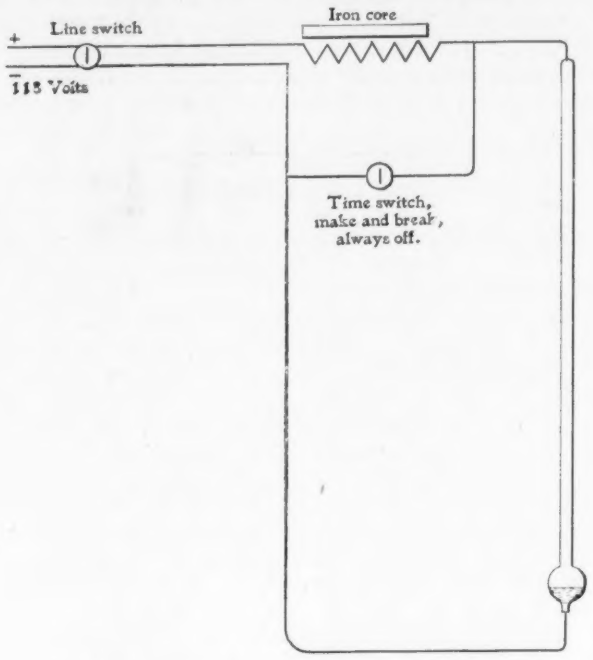


FIG. 3.—METHOD OF STARTING LAMPS.

found satisfactory in practical operation. It consists of an induction coil which is thrown in circuit in starting, its function being to boost the line e. m. f. to a degree sufficient to start the vapor discharge. After the tube has attained a normal state, which occurs in a very short time, the coil may be cut out. In some of the arrangements this latter operation is performed automatically.

Important Telephone Decision in Chicago.

Judge Tuley has rendered a decision in Chicago in the case brought by the Illinois Manufacturers' Association, the city of Chicago and several individual complainants against the Chicago Telephone Company. This case involved the right of the telephone company to charge more than $125 a year to a subscriber for a telephone instrument. The charge under special service contract is now $175 per vear. Judge Tuley granted a preliminary injunction against the collection of more than $125 per year, and further held that money which has been paid in the past in excess of that sum by subscribers can be recovered. The suit was based on the ordinance under which the telephone company has been operated, which fixes the maximum rate for a subscriber's instrument at $125.

The telephone company in its answer to the petitioners' bills set forth that the service now being given was a great improvement over that given at the time the ordinance was passed, and that although more than $125 per year was charged for this improved service, those who desired were still able to get the same kind of service which was afforded at the time the ordinance was passed, at the ordiance rate of $125. It was maintained that since the improvements of the art in recent years made possible the giving of a better service by putting in a complete metallic circuit and instruments suited to long distance service, the company had the privilege of giving its customers its improved service at an advanced price sufficient to cover the extra cost of this service as long as it gave its customers the option of taking the old grounded circuit instruments at the ordinance rate.

In the decision Judge Tuley said in part: "When a subscriber cannot obtain satisfactory service, except by entering into a contract by which he agrees to pay a greater rate than that fixed by the ordinance, the rate agreed to be paid so far as it is in excess of the rate prescribed by the ordinance must be held to be an illegal exaction, and not only illegal but forced, a forced agreement, by the company, exacted of the subscriber, and not a voluntary contract, which would stop him from disputing the same. The law does not require objection or protest to be made to the payment of unjust charges for the reason that it would be in vain, being addressed to those who occupy the commanding power to enforce obedience to their requirements. There is no contest made by the complainants as to the right of the company to charge extra for what is called extension service. With that exception, the service rendered under the special contract in question must be rendered by the defendant at the ordinance rate, $125 per annum. An order may be prepared in accordance with the views here expressed for a preliminary injunction as prayed for in the bill."

The Judge has evidently hinged his decision in part on the question of whether the $125 service now offered could justly be called adequate in the light of recent improvements, and in this connection the contentions of the telephone company's lawyers seem to have been used in an unexpected manner against the company by the Judge, for he says:

"The defendant's answer clearly shows the inadequacy and inefficiency of the old service for the changed condition of affairs." Various annual reports of the executive officers and stockholders were cited by the court in support of this statement.

Continuing the court said: "It is admitted that the defendant telephone company is a public service corporation, and analogous in many respects to that of a common carrier; that it must treat all its patrons alike and without discrimination. In that respect it must also be held to resemble a street railway corporation, and an ordinance granting to a street railway corporation the privilege of using the streets of the city for street railway purposes on the condition that it should not charge to exceed a certain rate of fare would be exactly similar in principle to the ordinance in question granting a telephone company the use of the streets, etc., on condition that it should not increase its rates for telephone service above a certain amount. The two ordinances were passed in the exercise of the same power of the municipality. If one is the exercise of the governing power, so is the other."

Reference was then made to a large number of court decisions cited in the trial of the case, regarding which Judge Tuley says: "Under the decisions quoted it became the duty of the defendant as a quasi-public service corporation, by reason of the passage of the ordinance and its acceptance and enjoyment of the privileges conferred thereby, to furnish telephone service with all the improvements thereon to its subscribers at the ordinary rate of $125 per annum, and no acts or acquiescence of its subscribers by signing or accepting telephone service under the special contract can be held to be an estoppal upon such subscribers or to confer upon the defendant a power which it has assumed to exercise in direct violation of the ordinance."

The case will be appealed. If the decision is sustained claims may possibly be made for past charges in excess of $125 per year, which have been collected of various subscribers. This would mean, according to the figures of M. B. Madden, president of the Illinois Manufacturers' Association, that it would cost the telephone company $2,000,000 for the settlement of these claims.

The Scope and Intent of the Carnegie Institution.

The following official announcement of the purposes of Andrew Carnegie in endowing the Carnegie Institution at Washington was made last week by Dr. Charles D. Walcott, secretary of the incorporators of the Institution:

Mr. Carnegie's purpose, as stated by himself in requesting the various trustees to become members of the board, is as follows: It is proposed to found in the city of Washington, in the spirit of Washington, an institution which, with the co-operation of institutions now or hereafter established there or elsewhere, shall, in the broadest and most liberal manner, encourage investigation, research and discovery; encourage the application of knowledge to the improvement of mankind; provide such buildings, laboratories, books and apparatus as may be needed, and afford instruction of an advanced character to students whenever and wherever found, inside or outside of schools, properly qualified to profit thereby. Among its aims are these:

1. To increase the efficiency of the universities and other institu-

tions of learning throughout the country by utilizing and adding to their existing facilities, and by aiding teachers in the various institutions for experimental and other work in these institutions as far as may be advisable.

2. To discover the exceptional man in every department of study, whenever and wherever found, and enable him by financial aid to make the work for which he seems specially designed his life work.

3. To promote original research, paying great attention thereto, as being one of the chief purposes of this institution.

4. To increase the facilities for higher education.

5. To enable such students as may find Washington the best point for their special studies to avail themselves of such advantages as may be open to them in the museums, libraries, laboratories, observatory, meteorological, piscicultural and forestry schools and kindred institutions of the several departments of the Government.

6. To insure the prompt publication and distribution of the results of scientific investigation, a field considered to be highly important.

These and kindred objects may be attained by providing the necessary apparatus for experimental work, by employing able teachers from the various institutions in Washington and elsewhere, and by enabling men fitted for special work to devote themselves to it, through salaried fellowships or scholarships, or through salaries with or without pensions in old age, or through aid in other forms to such men as continue their special work at seats of learning throughout the world.

The board of trustees elected by the corporators to carry out the purposes of the institutions as indicated is as follows: Ex-officio: The President of the United States, the president of the United States Senate, the speaker of the House of Representatives, the secretary of the Smithsonian Institution, the president of the National Academy of Sciences; Grover Cleveland, New Jersey; John S. Billings, New York; William N. Frew, Pennsylvania; Lyman J. Gage, Illinois; Daniel C. Gilman, Maryland; John Hay, District of Columbia; Abram S. Hewitt, New Jersey; Henry L. Higginson, Massachusetts; Henry Hitchcock, Missouri; Charles L. Hutchinson, Illinois; William Lindsay, Kentucky; Seth Low, New York; Wayne MacVeagh, Pennsylvania; D. O. Mills, California; S. Weir Mitchell, Pennsylvania; W. W. Morrow, California; Elihu Root, New York; John C. Spooner, Wisconsin; Andrew D. White, New York; Edward D. White, Louisiana; Charles D. Walcott, District of Columbia; Carroll D. Wright, District of Columbia.

It is understood to be the purpose of Mr. Carnegie to transfer $10,000,000 in 5 per cent bonds to the board of trustees for the purposes above mentioned. The meeting for organization of the board of trustees and the election of officers has been called for Jan. 29, at the office of the Secretary of State, Washington.

Nernst Lamp Lecture in Chicago.

Probably the largest gathering of local electrical men ever assembled in Chicago was on hand to listen to a lecture by Mr. A. J. Wurts on the "Development of the Nernst Lamp in America," delivered the evening of Jan. 10, in the large lecture hall of the Lewis Institute laboratories. This being the first public exhibition of the Nernst lamp in Chicago, many were practically interested in seeing the latest types of lamps and in hearing from the lips of one who had taken part in the work, the difficulties that have been found and overcome in the development of a commercial lamp.

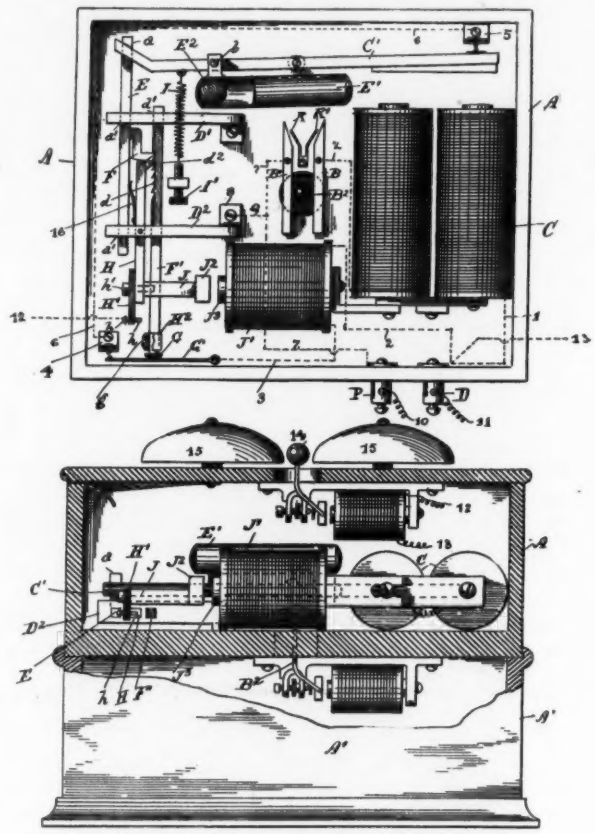
This lecture covered much the same ground as the paper by Mr. Wurts before the American Institute of Electrical Engineers at Buffalo last August, which was reprinted in ELECTRICAL WORLD AND ENGINEER of Aug. 31, 1901. For the main points of the lecture readers are referred to that paper. The lecture brought out some new points, however, and explained perhaps a little more fully the troublesome problems that came up and their solution. One statement made, to the effect that the life of the glowers varies almost directly as the frequency, was of considerable interest to the audience. For example, a glower with a life of 800 hours at 60 cycles will last 1200 hours at 133 cycles.

Much appreciation was shown by the audience as the speaker related the way in which small but important practical troubles had been overcome, such for example as the substitution of aluminum plugs inserted with pliers in place of binding posts for making connection with glower terminals, the embedding of the platinum terminal in the glower and the use of paste to make the removal of platinum black from the heater porcelain easy. The glower terminals, which are of platinum, get so hot that upon the expiration of the life of a glower it was found almost impossible to loosen the screw if the terminal was fastened in a binding post. As a substitute for binding posts the glower terminals are pressed into aluminum tapered plugs which accurately fit holes in the connecting rods of the lamp, into which holes they are tightly wedged with pliers to make the connection.

To illustrate the exact relation of the color of the Nernst lamp to the incandescent lamp, Nernst and incandescent lamps of equal candle power were shown side by side in ground glass globes and also side by side behind screens made up of bars of various colored paper. The room was alternately lit with Nernst lamps and with high candle power incandescent lamps taking an equal amount of energy, making a practical demonstration of the relative efficiency.

New Telephone Patents.

In the first issue of the Patent Office for this year telephony is represented by but two patents, one relating to our familiar friend, the party-line call-signal, the other to the more delicate problem of the service meter. Mr. Henry I. Hauxhurst, of Oakland, Calif., is the inventor of the latest device for supplying the party-line subscriber with one unmistakable ring on his bell when his attention is wanted instead of the confusing succession of rings customary on party lines not equipped with selective systems. Mr. Hauxhurst's device, which he terms a "telephone attachment," is literally such, as it is ararnged to be attached to the ordinary telephone set and to be actuated by the hammer of the telephone ringer, the gongs of the latter being transferred to the bell, which gives the signal when the step-by-step device or selector has done its work. Referring to the diagram, Fig. 1 is a vertical sectional view of the apparatus, and



HAUXHURST'S TELEPHONE ATTACHMENT.

Fig. 2 a cross-section top plan, showing the attachment secured to the box of an ordinary telephone bell. In Fig. 1, B^2 is the hammer of the telephone bell, adapted to vibrate when set in motion the two levers B B^1, and so cause them to close contact with springs K K^1. The magnet C operates on lever C^1, to which is attached a hollow case E^1, in which a steel ball E^2 rolls freely; C^1 is held away from the magnet by spring I, and its rear end bears against a projection a on the end of sliding rod E, which carries a dog F, engaging in the teeth d on sliding rod F^1. A lever H pivotted to the lower frame D^2 through which the sliding rods pass, has a tooth on its upper end, and

being pressed forward by spring 16 holds F^1 in position at any point to which it may have been raised. At right angles to H is attached a rod J carrying the armature J^3 of magnet J^1; an insulating block H^1 attached to the lower end of H carries a platinum pointed contact stud h, adapted to engage in the notch g of the insulating collar H^2 on connecting rod F^1 when h and g are opposite, and H is brought forward by magnet J^1 acting on armature J^3. When F^1 is at its lowest point it causes spring G^1 to break contact at 4; when C^1 is attracted it breaks contact at 5, interrupting the connection between wires 9 and 6. Wires 10 and 11 go to the local battery, and 12 and 13 to the bell magnets. The operation of the instrument is as follows: Suppose three bells indicate the call for the subscriber, to whose telephone the device is to be attached. In such case block H^1 is so adjusted, having a slot opening where it is screwed to H, that point h will be directly in line with notch g of collar H^2, when F^1 has been raised three teeth. When the central operator rings three bells in the ordinary way the hammer B^2 causes three contacts between B B^1 and K K^1, the vibrations of the hammer being so rapid as to constitute practically a continuous pressure while the vibrations last. Circuit is thus closed at each contact of B B^1 and K K^1 through C and C^1 is attracted, ball E^2 rolling down the case and aiding in depressing C^1; the outer end of C^1 raises E and the dog F raises F^1, one tooth in which position it is held by the dog on the top of H. During the pause between signals C^1 is released and E falls back one tooth, but C^1 does not rise far enough to close contact again at 5 before the next signal comes, C^1 is again attracted, and the operation of the sliding rods is repeated. When the third signal has been given C^1 returns to its normal position and closes contact 5; F^1 then having been raised three teeth h is in line with g, and contact 4 having been closed by spring G^1, no longer held down by F^1, magnet J^1 is energized, attracts its armature and so causes h to engage in g, thus making contact with F^1, and so closing circuit between the local battery and the bell. When the circuit is broken by the removal of the receiver from the switch hook, J^1 releases J^2 and spring 16 acting on H causes h to be withdrawn from g, allowing F^1 to drop to its normal position, breaking contact at 4 by pressing down G^1. The bell will not be rung by fewer than three signals, because F^1 will not be lifted up enough for h to be brought opposite g, nor by more, because the pause between signals is not long enough to allow C^1 to return to its normal position and close contact 5 and so energize J^1. In the case of stations not signaled where the signals are either too few or too many to effect the closing of the bell circuit J^1 acts as a restoring magnet after the completion of the signals by moving H so as to release F^1, which then depresses G^1 and breaks the circuit through J^1. The apparatus has been ingeniously worked out, and can claim the advantage of being adaptable to the ordinary telephone set, and the ordinary method of party-line signaling. It has the disadvantage, however, of number of moving parts, requiring very fine construction and careful adjustment to ensure regular performance.

Mr. Frank R. McBerty, of Evanston, Ill., assignor to the Western Electric Company, patents a service meter for multiple switchboards adapted for use in connection with common battery switchboards. It has been found in practice that a meter which registered a call only would be useless, if not worse than useless, since so much confusion would arise from the registry of calls not resulting in completed messages, the completed message or connection with the called station followed by an answer from that station being the unit of telephone charges. Consequently, a meter to be effective must register only when the called sub-station has responded to the call by taking the telephone receiver off the hook, the train of operations culminating at this step constituting a "message," or completed connection as far as the work of the telephone company is concerned. Last week we described an invention which sought to accomplish the same object that Mr. McBerty's device aims at, but in the persent case the solution is arrived at in a simpler manner, with less auxiliary apparatus, and with a delightfully ingenious arrangement of circuits. Briefly put, Mr. McBerty arranges his service meter in series with the cut-off relay of the calling line, and with the supervisory lamp of the answering line, and so fixes the resistance of the meter-magnet that it shall not become energized until, by the closing of the telephone circuit at the answering station the lamp is shunted and an increase of current is thereby produced in the meter circuit. As a safeguard against double registration of the meter, should the called station temporarily replace the receiver, a shunt is applied to the meter magnet, which is broken when the meter magnet is sufficiently energized to attract its armature and thereafter the meter magnet remains energized until the answering plug is withdrawn and the circuit through the cut-off relay broken. The reciprocal arrangement of the answering and calling-plug circuits and their respective supervisory lamps is novel and highly ingenious, and a difficult problem is solved in a simple manner, which is one of the truest tests of inventive ability.

Pacific Cable Before Congress Committee.

At Washington, on Jan. 10, the House Committee on Commerce took up the subject of a Pacific cable. The main question is whether the cable shall be constructed by the Government or by individuals, and this hearing was devoted to a statement by Mr. George G. Ward, vice-president of the Commercial Pacific Cable Company, as to the plans of that organization. He said that contracts had been made for the manufacture and laying of a cable to Honolulu by Nov. 1 next, and that the company intended to extend the cable to Manila within two years thereafter. The manufacture of the cable was now proceeding, he explained, at the rate of 240 miles a month, and this rate would be increased to 630 miles a month. He said that the cost of the project was between $10,000,000 and $12,000,000. The cross-questioning by Chairman Hepburn (Rep., Iowa), and Messrs. Corliss (Rep., Mich.), and Mann (Rep., Ill.), tended to develop the question whether or not the company, by having an exclusive field, would maintain high rates. Mr. Ward said he expected the rate to Manila to be $1 and to Honolulu from 35 to 50 cents a word. The company he represented would be able to make exclusive traffic arrangements from points beyond the Philippines and connecting with China and Japan. He also stated that there would be questions as to the right of the United States to land a cable on foreign shores. Representative Stewart (Rep.), of New Jersey, interposed the statement that Germany's present course against Venezuela showed that the German Government made little distinction between public and private rights, so that a government cable station would have about the same status as a private station.

Chairman Hepburn (Rep., Iowa) asked a series of questions as to the effect of wireless telegraphy on the submarine cable. Mr. Ward replied that the new system presented a serious question. He was not certain that the Pacific cable project would have been undertaken if the long-distance experiments had occurred earlier. As to the claims that wireless signals had been conveyed 2000 miles across the Atlantic, he said that if the claims were made good they would deter people from laying any more cables. When asked as to the effect thus far on the cable business, he replied that it had depressed cable interests.

Mr. Stewart wanted to know if the cable companies had not chased Marconi out of Canada, to which Mr. Ward answered that he believed the cable companies had insisted upon certain exclusive rights they held. Mr. John Foord stated that the American Asiatic Association, representing the firms doing business in the Orient, favored a cable under private control. It was opposed to the Government entering the field of private enterprise.

President Scrymser, of the South & Central American Cable System, made an extended argument favorable to government control of the Pacific cable, citing incidents of the Spanish-American war, showing the importance of governmental control of the cable. In one case cited the Spanish Minister of Marine called Admiral Cervera to leave Santiago. If this dispatch had not been intercepted, Mr. Scrymser said, the battle of Santiago Bay would not have been fought and the conduct of the war might have been changed.

Thomas E. Hughes, representing an American company, stated that as good cable could be made in the United States as in any other part of the world. He asked that American labor and capital have the advantage of doing this work. Chairman Hepburn asked if this American company was prepared to make a definite business proposition to the United States Government, and Mr. Hughes replied that such a proposition would be submitted in due form within the next two days. Mr. Hepburn asked that the formal proposition be in alternative form—first, for delivering a cable of American make at San Francisco; second, for making and laying the cable to Hawaii, Guam and Manila. Mr. Hughes thought the Government better able to do its own cable laying, using the army transports. As indicating the general character of the forthcoming proposition Mr. Hughes said the cost would be within 10 per cent of the stated cost of the Commercial Pacific Company's cable. The additional 10 per cent, he said, was for the protection of American industry.

Francis B. Thurber, president of the United States Export Asso-

ciation, favored private construction as most likely to give the earliest cable advantages to the business world.

William W. Cook, of New York, a director of the Pacific Commercial Cable Company, said that the company, after laying the cable across the Pacific, stood ready to sell it at any time to the United States Government at an appraised valuation.

Mr. Ira W. Henry, civil engineer for an American cable manufacturing company (the Safety), said his concern would furnish the Government a cable at $1,000 a mile, which, to Hawaii, would amount to about $2,200,000, or considerably less than the cost of a foreign-made cable.

The hearings will be continued this week on Friday, when Government officials will be heard on the Government project.

CURRENT NEWS AND NOTES.

WIRELESS TELEGRAPHY IN HIGH LATITUDES.—A dispatch from Copenhagen, Denmark, states that Iceland, Greenland, the Faroe Islands and Canada may soon be in communication with one another by the Marconi system of wireless telegraphy. Iceland, it is said, will spend $45,000 for this purpose, and is already negotiating with Mr. Marconi for the installation of the system between Iceland and the Shetland Islands.

WIRELESS TELEGRAPHY IN CANADA.—Before leaving Ottawa for New York last week Mr. Marconi said he had decided to establish his wireless telegraphic station for this side of the Atlantic at a point in Cape Breton to be decided upon later. It is also announced that the Dominion Government will give a very handsome grant toward the initial expense. The Canadian Government will also test wireless telegraphy stations on the St. Lawrence Gulf.

LONG ISLAND SOUND CABLES.—A new cable two miles long is soon to be laid across Fisher's Island Sound. A telephone station is to be established at North Hummock Island, east of New London, which will be a new point for communicating news affecting shipping interests. This will be the fifth point of the kind on the Connecticut shore of the Sound, and a sixth will probably soon be added by laying a cable from Stratford Point to Middle Ground Shoal lighthouse.

LOCATING METAL ORES.—A patent issued Dec. 31 to Fred. H. Brown describes an application of the Wheatstone bridge principle in the location of metallic ores, minerals, etc. The source of current for the bridge arrangement is an induction coil, and a telephone is utilized in obtaining a balance. Two terminals from ends of one arm of the bridge are inserted in the earth at various distances apart, the earth thus becoming the unknown resistance in this arm of the bridge; the value of this resistance is then measured in the usual way.

DETROIT MUNICIPAL TELEPHONY.—Since the recent advance in telephone rentals by the Michigan Telephone Company, the Merchants' and Manufacturers' Exchange has been investigating, through a committee, the desirability of establishing an independent company. The committee has just met and decided upon a report in favor of buying a co-operative telephone plant, but not the People's Telephone Company, which would ultimately be taken over by the municipality as soon as an act could be passed by the Legislature authorizing municipal ownership.

PNEUMATIC TUBE SERVICE.—A telegram from Washington, of Jan. 10, says: Representative Roberts, of Massachusetts, today introduced a bill for the re-establishment of the pneumatic tube service in the leading cities of the country. Its distinguishing feature is its taking away from the Post Office Department discretion in the matter, and the express stipulation by Congress of the places where the service is to be installed and the amounts to be severally paid for it. It is hoped that, as an offset for the rural free delivery appropriations for the benefit of the country districts, the tube service may be granted to the larger cities, as recommended by the Postmaster General.

BOOSTER PATENTS.—Four patents were issued Jan 7, 1902, to H. Ward Leonard based upon applications filed 1892 and 1895 by G. T. Wood and relating to the control of e. m. f. upon the terminals of a translating device by means of a controllable auxiliary e. m. f. The claims of one of the patents also relate to the form of motor control known as the "teazer system," the application for this patent having been filed a number of years before the commercial introduction of this system. Among the claims of this patent are several which refer to the use of the rotary transformer on an electrically propelled vehicle. The applications for these patents were in interference with the claims of some twelve other patent applications while they were in the Patent Office, which explains the long interval between their date of application and their date of issue.

NATIONAL WEALTH CONDITIONS.—The standing of the United States with her neighbors, and especially with those of Europe, is illustrated by some statements made by the *London Daily Mail Year Book* for 1902, a copy of which has just reached the Treasury Bureau of Statistics. In its various chapters it discusses various features of conditions in the United States. Under the head of Wealth it places the United States at the head of the list of great nations, the figures of wealth being: United States, £16,350,000,000; United Kingdom, £11,806,000,000; France, £9,690,000,000; Germany, £8,052,000,000, and Russia, £6,425,000,000. While the United States heads this list of countries in its wealth, it shows the smallest national indebtedness, the figures being: United States, £221,000,000; Germany, £651,000,000; United Kingdom, £706,000,000; Russia, £711,000,000; France, £1,239,000,000. The percentage of debt to wealth is given as: United States, 1.4 per cent; United Kingdom, 6 per cent; Germany, 8.1 per cent; Russia, 11.1 per cent; France, 12.8 per cent.

A FREAK PATENT.—Predicating the fact that electric currents flow through the earth and are now wasted, Emil Jahr, of Berlin, in a patent issued last week, describes a method for utilizing such currents. He claims that the existence of such earth currents is shown by thrusting two metal plates at a certain distance from each other into the ground in the direction of the magnetic meridian and connecting them above the ground by means of a wire, including a galvanometer. He says that the stronger currents of this kind have been shown to flow from north to south. Notwithstanding that these facts have been known, the earth current has never, he says, been utilized, and he proposes to take advantage of this source of energy. He claims to have discovered that the current produced is at the highest tension when the two metals are most widely separated from each other in the electrical potential series; that which is nearer to the zinc end of the series is thrust into earth or water at the more northerly point, while that which is nearer the negative end of the series is thrust into the earth at the southerly point. In such an arrangement the metals are not, he says, appreciably corroded even when they are in earth saturated with water and are connected together for a long time. The invention consists in using electrodes of this character, the line connecting the same being situated in the direction from north to south and also in the direction of the magnetic dip.

INTERNATIONAL TELEGRAPH UNION.—It is stated that General Greely is naturally interested in the International Telegraph Union, and is anxious that Congress give the War Department authority to join. He is quoted as follows: "As compared with the contracting States the United States is now at a distinct disadvantage in the use of cables and land lines which pertain to the union. In time of war or in exigencies the United States has to yield in priority to the official messages of agents of all contracting States, as under the regulations telegrams of contracting States take precedence. The International Telegraph Union furnishes the contracting States gratuitously all information relative to international telegraphy, such as interruptions, restorations, etc., and the United States has been obliged for years past to obtain such information second-hand and as a favor, if at all. The expense of the maintenance of the international bureau is borne by the different States, and would probably not exceed a few hundred dollars per year for the United States. Prior to the Spanish-American war, Porto Rico and the Philippines participated in the advantages of the union, and there seems to be every good reason why they should continue to adhere to it, especially in view of the fact that foreign cables reaching these islands conform to the regulations of the International Telegraph Union." These remarks confirm those of Mr. G. G. Ward as to the Pacific cable.

THE NEW YORK CENTRAL TUNNEL.—The New York Central authorities have entered into a contract with the New York Edison Company for the installation and current supply of arc lamps for lighting the tunnel. Nothing definite appears yet to have been decided upon with respect to the electrical equipment of the tunnel, though the newspapers daily make statements to the contrary, the non-authoritative nature of which is indicated by their conflicting character.

CANADIAN ELECTRICAL ASSOCIATION.—A meeting of the executive committee of the Canadian Electrical Association was held in Montreal on Jan. 10 for the purpose of arranging the preliminary programme of the annual convention, which is to be held in Quebec in June. At the meeting it was announced that Mr. Fred Nicholls, manager of the Canadian General Electric Compay had offered $500 to the association for the purpose of stimulating electrical study and research. It will probably be spent in the form of prizes for papers on electrical subjects.

LORD KELVIN COMING.—We are enabled to state upon the best authority that Lord Kelvin will visit this country once more early next April, doubtless accompanied by Lady Kelvin. The great physicist is now well advanced in years, and we are heartily glad to learn that he is in such robust health as to be equal to a long ocean voyage. Electrical engineers will, of course, take proper steps to show him honor, but it must once more be a matter of regret that the Institute is still without a home of its own in which to entertain him. In fact, no engineering body here has a building large enough for such a purpose.

FRENCH TELEPHONE RULES.—It is stated from Paris that new regulations issued for telephone girls are causing endless amusement. One clause forbids their ever calling subscribers to converse with them. Another forbids them to answer flatteries, compliments or pleasantries from men subscribers. The telephone girls are forbidden to make appointments over the wire or to permit gentlemen, even though relatives, to wait for them near the office. Juliette Adamson, an American girl, has just been fined $40 for insulting over the wire a tradesman who failed to deliver goods at the promised time. Her defending attorney argued that as long as a subscriber paid the State could not restrict conversation, but the Judge held that the State has the right to enforce an order regarding telephones just as it has regarding streets.

PREVENTION OF TRAIN ACCIDENTS.—A special cable dispatch from Vienna, of Jan. 11, explains the following, which is very like some American plans: An automatic railway accident preventer, invented by an electrician named Rudolph Bartelmus, has been tested by a body of expert railway managers with satisfactory results. The main idea is to put the engineer in direct communication with all the signal boxes by electrical apparatus on the engine, contact being effected by a third rail. The signalman can thus make a red light burn on the locomotive in front of the engineer, while an electrical bell will ring until the engineer switches it off. On the other hand, the contrivance causes a bell to ring in the signal box as soon as the train is within 3000 yards. Finally, if one train approaches another on the same rail within 3000 yards, red lights burn automatically on the locomotive.

USE FOR CHICAGO WIND.—In a lecture before the students in the College of Commerce and Administration at the University of Chicago on Jan. 10, Franklin H. Head suggested a novel method of illuminating the city. He presented as a possibility of the future the use of a belt of windmills, running dynamos which would charge storage batteries with electricity. A series of windmills around Chicago, he believed, say, for 40 miles, could supply storage batteries with enough electricity to light the whole city continually, and possibly to heat it, too. Mr. Head's remarks were made to illustrate the great value to the world of the new storage battery invented by Mr. Edison. In addition to these features, Mr. Head was of the opinion that the invention would be of great value otherwise. To the manufacturer, he said, it would answer all purposes of present facilities, and, furthermore, would be a great saving in power.

AN AERO CLUB FOR BOSTON.—New England is to have a club for aerial navigation, like the one recently formed in London. The name adopted is the Aero Club of New England. The men interested held a preliminary meeting last week in the rooms of the Massachusetts Automobile Club, and those who signified their intention of becoming charter members are Charles J. Glidden, George E. McQuesten, William A. Rolfe, Newton Crane, J. Ransom Bridge, Dr. Joseph C. Steedman, Royal B. Sheldon, Arthur W. Steedman, Dr. F. D. L. Rust, Ernest L. Reuter and Henry L. Howard. The new organization will study the general subject of aerial navigation, but more particularly is intended to make ascent and to own an airship. If this is agreed on, the machine, it is said, will be constructed on the Santos-Dumont principles, and steered electrically.

WIRELESS TELEGRAPHY ON THE ATLANTIC.—On his return home Saturday, in the course of an interview, Senator Depew said: "We had a very interesting experience with the possibilities of wireless telegraphy at sea on our way over. I sailed on the 'Kaiser Wilhelm,' and the 'Lucania' was behind us. Both are equipped with the Marconi apparatus. When we were out about a day we picked up the 'Lucania' and began talking with her. She was about 25 miles astern then. We talked to her every day in this way, and on the third day we were 100 miles ahead of her. We had been running through a dense fog, but had come into bright, clear weather. In a very short time that day we picked up the 'Lucania' and told her what fine weather we were having, and she replied that she had struck the fog and was in the thick of it. It is wonderful to think what all that will mean in the way of diversion in ocean voyages when all the steamers are equipped with the wireless telegraph apparatus, to say nothing of what it will mean in case of danger. Suppose the 'Lucania' had been in distress that morning. She could have told us all about it, and we a hundred miles away."

SIMPLE PHOTOMETRY.—In a paper read recently before the Kansas Gas, Water and Electric Light Association, Professor Lucian I. Blake described a simple photometer arrangement which he said gives excellent results. It is based upon the fact that any ordinary newspaper can be easily and satisfactorily read when its illumination is 1 candle-foot; that is, a candle at 1 ft. distant gives sufficient light for easy reading. Moreover, a room is excellently lighted in every respect if a newspaper can be read at any place in the room, or, in other words, if the illumination does not anywhere fall below 1 candle-foot. The apparatus consists of a box with two openings side by side at one end, one of which is for the eyes and the other to admit the light from the lamp to be tested. The shape of the box cuts off all other light. The side opposite the two openings is about 13 inches distant and a newspaper clipping is placed against this side. If the box is turned toward a single 16-cp lamp 4 ft. distant and the paper is easily read, the lamp is giving a satisfactory light. Lamps can thus be tried rapidly and in succession by the consumer himself. Professor Blake believes that 100 lamps an hour can be tested in this way, and closely enough for all commercial purposes.

THE GERMAN NERNST PATENT.—The current issues of several of our European contemporaries refer to an adverse decision of the German Patent Office on a Nernst lamp patent. The *Elektrotechnische Angeiger* states that the patent in question is the German patent No. 104,872, of July 6, 1897, from which it gives an extract briefly as follows: "A method for making electric light by means of rods, tubes, etc., of conductors of the second class which are insulators at ordinary temperature, but become good conductors at high temperature, and characterized by the feature that the current is started by means of pre-heating the total incandescent body, the conductor being subsequently kept hot and incandescent by means of the current." An official of the Allgemeine Elektricitats Gesellschaft stated that the decision referred to is not final, as the Reichsgericht (Supreme Court) has still to give its decision on appeal. There are altogether 14 patents on Nernst lamps, and the principal ones on the incandescent body and automatic starting cannot be questioned, as they have been granted on the basis of careful consideration and preliminary examinations by the Patent Office. The official stated that it is to be assumed that the courts will confirm these patents should a litigation be instigated, and that the protection to the manufacturer of the Nernst lamp is not affected by the above decision.

MUNICIPAL TROLLEYS.—By the order of Mayor Tom L. Johnson, a bill is being drawn to authorize the city of Cleveland to issue bonds to build or purchase a street railway system. The measure allows the city to issue bonds for not to exceed $50,000 for each mile of single track to be constructed. As drawn, the bill contemplates an affirmative majority vote of the people before the bonds are issued.

TELEPHONES ON COLORADO TRAINS.—Plans are now under way to install telephone instruments on all trains running across the State of Colorado. At all large stations sockets and switches will be located so that when trains stop one of the crew will instantly connect the train system with the Denver exchange, and through it to the long-distance circuits. Connecting switches will be placed at Denver, Greeley, Boulder, Palmer Lake, Colorado Springs, Pueblo, Salida, Alamosa, Durango, Grand Junction, Florence, Cripple Creek and Victor.

METAPHYSICAL METERING.—In discussion of the Wright demand meter principle as brought before the English Institution, the *London Electrician* raises this rather amusing point: "There is one question which we should like to have heard asked of Mr. Wright in regard to his system of charging, viz., Is it legal? After its extensive use for so many years it may, perhaps, seem superfluous to ask such a question. Yet it is a question that may advantageously be followed up. According to the law, as we understand it, preferential charging is illegal. In other words, a supply station manager may not say to a publican: 'You are a most desirable customer, I will charge you only 2d. a unit,' and then say to the dean of a cathedral: 'Your cathedral is an intolerable nuisance, I must charge you 8d. per unit.' We are quite aware that in some few places the tariffs are arranged on these bold lines—preferential charging, pure and simple. Now the Wright demand indicator is really an instrument for automatically making preferences of mathematical exactitude and unimpeachable equity. There can be no element of personal prejudice in its indications, yet, nevertheless, the final result is undeniably preferential charging. It is a refined point, as to whether this automatic preferential tariff is legal, when the balder form of it is certainly not. And if the tariffs obtained when using Mr. Wright's instrument are *sans reproche* in the eyes of the law, are not also the general classifications of consumers which are finally arrived at by means of that instrument? In other words, if general experience over an extensive area indicates that publicans, say, are the best consumers, provision stores the next best, and churches the worst of all, may not the manager of a new supply undertaking arrange his tariffs accordingly without ever using the demand indicator? The net result should be the same as if the indicators were to be installed, except, of course, that in the latter event the individuals would be provided with a means of escape from the invidious consequences of class distinction. It may be that in this element of free will and means of escape for the individual subtly lies the legality of the Wright system—a reflection that conjures up abstract philosophic recollections far enough removed from the business of electric supply. An essay on the Wright system by a modern Kant or Jonathan Edwards would prove curious reading for Christmas."

LETTERS TO THE EDITORS.

Theory of the Edison Nickel-Iron Cell.

To the Editors of Electrical World and Engineer:

Sirs.—Mr. Woolsey McA. Johnson's communication, published in your issue of Jan. 11, fails to prove anything regarding the main point at issue in our controversy. Mr. Johnson claims that I have "misquoted and misunderstood" him. I deny that I have misquoted him in any way. That I misunderstood him is not my fault, for two reasons.

First, Mr. Johnson uses the term "aqueous tension" in a sense which appears to be original with him. At least, I have looked over quite a number of books on chemistry and physical chemistry, and I have consulted prominent chemists, but I have failed to find any one using the term "aqueous tension" for what is always called vapor tension or vapor pressure. Indeed, there is no reason whatever to give up these good old terms, which signify exactly what they mean, and to replace them by the ambiguous term "aqueous tension." I do not see that it helps Mr. Johnson to refer now to the German term dampfspannung. Dampf is vapor in general, and dampfspannung is vapor tension, not necessarily vapor tension of water.

Secondly, in his original article Mr. Johnson gave his formula as an argument to prove that an increase of the concentration in the pores of the one electrode of the new Edison cell with a simultaneous decrease of the concentration in the pores of the other electrode (the total concentration being unchanged) could not have any great influence upon the e. m. f. of the cell. It is this statement which is the point at issue in our discussion. Mr. Johnson gave his formula with the utmost brevity and without any proof. So I had to consider it in the light of the conclusion which he deduced from it regarding the Edison cell. This I have done, and hence my misunderstanding. The only way in which it would have been possible to use the formula for obtaining the above conclusion regarding the Edison cell (although by a faulty argument) was to consider the formula in the way I believed, at that time, Mr. Johnson meant it. On the other hand, from the theory now given by Mr. Johnson, it is impossible to deduce the above conclusion regarding the Edison cell. Mr. Johnson considers a cell with a reversible metallic oxide electrode, a reversible hydrogen electrode, and a KOH solution, and he calculates the difference of the e. m. f.'s of two such cells with different concentrations of the KOH solution. This is very interesting, but as I have said in my last article—and Mr. Johnson has not replied to this point of my criticism—the hydrogen electrodes in both cells here introduce only complications. The difference of the e. m. f.'s calculated by Mr. Johnson does not give the variation of the e. m. f. between the nickel peroxide plate and the solution alone, but it gives it together with the variation of the potential difference at the hydrogen electrode. Hence, while the difference of the e. m. f.'s of the two cells may be very small, this does not necessarily mean that the difference of the e. m. f.'s between the nickel peroxide plate and the solution in the two cases must be small.

The correctness of my criticism is very clearly brought out by some instructive measurements, described by Dr. F. Dolezalek in the very book to which Mr. Johnson refers: "Die Theorie des Bleiaccumulators," on page 41 to 44. It is there stated there that the e. m. f. of the spongy lead plate in the lead accumulator with respect to a hydrogen electrode increases with increasing concentration of the acid, while the e. m. f. of the same plate with respect to a mercurious sulphate electrode is practically independent of the concentration. Dr. Dolezalek draws the correct conclusion that measurements of the e. m. f. of a separate electrode against such auxiliary electrodes (like the hydrogen electrode and the mercurous sulphate electrode) do not give a clear insight into the variation of the potential of the electrode under test, alone, because the potential of the auxiliary electrode also changes, so that the same plate may appear to behave differently against different auxiliary electrodes.

Finally, Mr. Johnson briefly states that the e. m. f. of a cell of the oxygen-lift type is nearly independent of the concentration. This is also very interesting, but it again does not touch the point at issue. What Mr. Johnson finds to be practically zero, is the difference of the e. m. f.'s of two Edison cells of different total concentration, but the concentration in each cell being uniform. The point at issue, however, is an entirely different one, namely, the determination of the difference of the e. m. f.'s of two Edison cells of the same total concentration, but differing in so far that in the one the concentration is uniform throughout the cell, while in the other the concentration in the pores of one electrode is greater than the total concentration, and that in the pores of the other electrode is smaller to the same degree. Mr. Johnson's calculations—though they are certainly interesting—do not prove anything concerning this vital point.

This is why I still must consider the whole matter as an open question. It will, however, be relatively easy to settle it by experiment, after the Edison cell has been placed upon the market.

E. F. ROEBER.

PHILADELPHIA, PA.

Engine Specifications.

To the Editors of Electrical World and Engineer:

Sirs.—I should like to put a query through your paper on a technical question, which is of much importance to central station men at the present time.

Not a little difficulty is encountered in getting contracts from en-

gine builder and dynamo builder covering the matter of parallel operation of alternators. The engine builder in his specifications guarantees a certain speed regulation for his engine, and the dynamo builder guarantees that the alternators will work satisfactorily in multiple, providing the maximum angular displacement in one revolution of a point on the periphery of the engine flywheels does not exceed 7/100 of an angular degree from the position of a reference point upon the periphery of a wheel revolving with absolute uniformity at the normal generator speed. This departure from uniform rotation corresponds to an electrical phase displacement of 2½ degs.

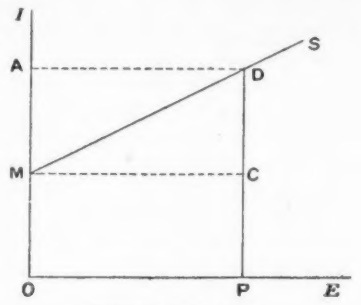
The point which I would like to ask through the columns of your paper, is whether there is a clause which can be stated in plain English which will protect the customer, yet be fair to both the generator and engine builders, and cover the successful operation of engine type alternators in parallel operation. It will be readily perceived that the regulation guaranteed by the engine builder of, say, 2 per cent, from no load to full load, and the requirement of the dynamo builder relative to angular displacement, do not cover the same ground and, consequently, the customer must assume the responsibility for the successful operation of his apparatus.

BOSTON, MASS. CHAS. M. BERTRAM.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Testing Dynamos.—BIENAIME.—The losses in a dynamo are the sum of the Joulean loss in the armature, the Joulean loss in the field and the power required to turn the machine as a motor unloaded in the same flux and at the same speed. This power is found by the method of Swinburne, who runs the machine as motor unloaded so that its speed is the same which it has as generator, and that the counter e. m. f. of the motor is equal to the total e. m. f. of the machine running as generator in order that the flux is the same in both cases. The e. m. f. which is required for this test must evidently be greater than the normal voltage at the terminals of the machine running as generator (at least by the amount of the loss of voltage in the armature). The present author describes the following method for which an artificial source of e. m. f. of lower voltage is sufficient. If a separately excited dynamo is run as a motor unloaded the speed is proportional to the e. m. f. *E* applied at the terminals of the armature. Furthermore, the e. m. f. *E* is a linear function of the current *I*



TESTING DYNAMOS.

which flows. In the adjoining diagram the ordinates are *I* and the abscissas *E* and the straight line *MS* represents *E* as function of *I*. The length *M O* represents the current required for starting. For a voltage represented by the abscissa *O P*, the hysteresis and friction losses are given by the surface of the rectangle *P O M C*, the eddy current loss by the surface of the rectangle *M A D C*. This diagram can, however, be plotted by making a test at a lower voltage than the normal voltage of the dynamo. At constant excitation, the e. m. f. at the armature terminals of the motor running unloaded, is equal to the speed multiplied with a constant which depends upon the flux and the number of turns. Therefore, in the test the excitation is to be adjusted so that the equation just mentioned is fulfilled, the constant in it being known. The excitation is then kept constant and the current is mesaured for various e. m. f.'s and the diagram is then plotted.—*L'Ind. Elec.*, Nov. 25.

Testing and Management of Motors.—WHITE.—The first part of an article in which he abhors the use of involved algebraical formulas for central station testing, and gives some practical hints. For motor testing the "artificial load" method is the best, and the one most generally used, but when a testing tank is used, the greatest care is necessary. An ammeter in the circuit and proper cutouts are absolutely necessary. It will pay to fit up a properly equipped testing board even when very little testing is done. An important adjunct of any station with pretension to a power load is a small alternator of, say, 15 to 25 hp, having a terminal voltage of 2000 or 3000. With the help of this it is easy to reject faulty machines, as 2000 volts alternating between winding and frame will soon bring to light in more than one way the weak points in a bad machine; of course, several machines can be submitted to this test at the same time. In connection with this, he mentions another method of testing motors, which he would like to see come into use more generally. With the help of a short countershaft having different sizes of pulleys to suit the varying speed requirements of different motors, the alternator can also be used to furnish a load of incandescent lamps through a suitable transformer. He sees no reason why the required load should not be the station lighting load.—Lond. *Elec. Rev.*, Dec. 27.

Cooling of Transformers.—SESSIONS.—In a California power house difficulties were experienced during the summer with transformers which got very hot. It was found that some other means than radiation of the air must be used. The following method proved satisfactory. The oil in the transformers is pumped through long coils of iron pipe, which are placed in the tail race in such a manner that the discharge from the waterwheels plays over them, reducing the temperature well below that of the oil coming from the transformer. These cold pipes cool the oil and return it to the transformers, keeping them much cooler than they would otherwise do. A table is given, showing the results of temperature measurements.—*Jour. of Elec.*, Nov.

Breaking of Shafts in Direct-Coupled Units.—An editorial note stating that the breaking of shafts in direct-coupled units, due to oscillations set up at critical speeds, is not a phenomenon of frequent occurrence, yet on some few occasions shafts have fractured under circumstances which appeared inexplicable, except on the hypothesis of a resonance effect creating cumulative stresses. Reference is made to a recent mathematical paper by Frith and Lamb, read before the Manchester section of the (Brit.) Inst. Elec. Eng. "The moral is that direct-coupled sets should be so designed that there shall be no possibility of the natural period of oscillation of the shaft synchronizing with the pulsations of the engine."—Lond. *Elec.*, Dec. 27.

REFERENCE.

Synchronous Converter.—RUSHMORE.—An illustrated article on the practical use of the synchronous converter and the phenomena of its operation. Hunting is discussed at some length, also the methods of starting. Some notes are given on speed control and on compounding.—*Eng. Mag.*, Jan.

LIGHTS AND LIGHTING.

Crawford-Voelker Lamp.—An anonymous communication referring to the article on this new English lamp, which was recently abstracted in the Digest. It is pointed out that in Holden's report the voltage and candle-power of the lamps tested are not stated, and that, therefore, the comparisons made are unfair. An editorial note says that the lamps tested by Holden were evidently 8-cp, 200-volt lamps, although this is not definitely stated.—Lond. *Elec. Rev.*, Dec. 20.

REFERENCES.

Blue Printing by Electric Light.—REIST.—His illustrated paper in full on the method used by the Gen. Elec. Co. for making blue prints by electric light.—*Transactions Am. Soc. Mech. Eng.*, v 22, 1901.

Incandescent Lamps.—Swenson.—An illustrated article on the methods used in the U. S. for making and testing incandescent lamps. —*Cassier's Mag.*, Jan.

POWER.

Economy of Electric Driving.—Marshall.—An abstract of a paper on "Electricity as a motive power, and its relation to economy." He considers the installation of electric power in a textile factory. He thinks an individual motor for each machine would be too expensive, and, therefore, prefers to install one motor in each department with shafting. He gives an estimate of the power required in the different departments and of the cost of the installation. He estimates the total cost of a complete electric plant for 500 hp with a direct-driven high-speed dynamo at $33,380, while the initial cost of a steam driving plant is only $26,950. Thus there is a difference in capital outlay in favor of steam of 20 per cent less than electricity. The extra annual cost of running and maintaining the electric plant he estimates at $1,650. Steam driving appears, therefore, more economical. But if a new factory were being built, and the supply of electricity for the motive power were got from some outside company and the steam engine, main gearing, and other lines of shafting used in transmission of power as well as the boiler, were dispensed with, a very considerable amount of outlay of capital would be avoided, and in case of a further amount of power being wanted it would only be a matter of putting down another. This is a very important consideration in favor of electric driving.—Lond. *Elec. Eng.*, Dec. 20.

REFERENCES.

Niagara Falls Power.—Barton.—A well illustrated article on the organization of the operating department of the Niagara Falls Power Company.—*Cassier's Mag.*, Jan.

Steam Turbine.—Thurston.—A very long illustrated paper on the steam turbine, "the steam engine of maximum simplicity and of highest thermal efficiency."—*Transactions Am. Soc. Mech. Eng.*, v. 22, 1901.

Gas Engine.—Sargeant.—An illustrated paper on "A new principle in gas engine design."—*Transactions Am. Soc. Mech. Eng.*, v. 22, 1901.

Flywheel and Angular Variation.—Astrom.—A long illustrated paper on the calculation of flywheels for keeping the angular variation of an engine within a fixed limit.—*Transactions Am. Soc. Mech. Eng.*, v. 22, 1901.

Power in Mills.—Walsh.—An article on electricity in Southern cotton mills.—*Elec. Rev.*, Jan. 4.

Electricity in Manufacturing Works.—Aldrich.—His paper in full, together with the discussion which followed, on "Requirements of electricity in manufacturing work, an abstract of which has been mentioned before in the Digest.—*Transactions Am. Soc. Mech. Eng.*, v. 22, 1901.

Electric Elevators.—An illustrated article on the electric lifts of the City & South London Railway. They are 26 in number, the capacity ranging from 55 to 100 people, and the ordinary working speed being 180 ft. per minute.—Lond. *Elec. Rev.*, Dec. 13.

TRACTION.

Load Factors and Circuit Breakers in Traction System.—An anonymous article. Observation has shown that the load factor naturally and markedly improves with the number of cars at work. The maximum load that practice has decided upon as allowable, and as really determining the load factor, is that which can be suffered to occur many times daily. Any further maximum is disallowed by the main circuit breaker, for this is set to act in a way to forbid the severe effects of an occasional simultaneous starting of many cars. These simultaneous startings are more apt to occur when cars are fewer, and embrace a larger proportion of the total load, and this is why it is that circuit breakers must be set proportionately higher for few than for many cars. The setting of the main cut-out is a matter of real importance. If set too low, the cut-out will act too often. Cars will constantly find themselves without current. If the circuit breaker is reset quickly the load factor will be improved. On the other hand, when circuit breakers are set unjustifiably high, they will rarely act, and will expose the machinery to unnecessary and undesirably high stresses, at the same time the load factor will be reduced. Between these two extremes there is a point at which the instrument should be set by experiment. It should always be set low to begin with, i. e., it may be set to act when the current is from 50 to 30 amperes per running car, according to the size of the station. If, with the first setting, it acts too frequently for the convenient working of the station, it may be then screwed up to a higher pitch, but not so high that it ceases to work from time to time. While the heavier draughts of current by several cars may occasionally synchronize, all such efforts are preferably to be eliminated by the action of the circuit breaker which cuts off the high peaks of the autographic record, and reduces the maximum flow of current to such a multiple of the mean current as practice has shown to be reasonably consistent with convenience of working, and the safety of the station. The circuit breaker, in fact, seems to effect the best compromise between opposing interests. A circuit breaker is too often regarded simply as a device for taking care of short circuits and cable damages. Quite as important is it that it should cut off what would be the excessive peaks of the load diagram. It is not desirable that on an up-grade of considerable angle a car should be deprived of power. It is, therefore, right that lines of severe gradients should be allowed a higher maximum current than is proper in more level systems. A fairly approximate prognosis of the load factor, and the average current per car, is important not only for the design and provision of the station outfit, but also for the design and copper contents of the distribution system. The rapidly augmenting weight of later cars will materially affect the total current consumption, but will probably have but small effect upon the load factor, as this is dependent upon the number of individual loads, rather than upon the size of such loads. Still, it is desirable that statistics should be kept, and made available for all running systems, showing all the conditions and the power consumption, car hours and mileages, etc., without which knowledge the design must be more or less a matter of guesswork.—Lond. *Elec. Rev.*, Dec. 27.

Accelerometer.—Corey.—An illustrated paper, read before the Am. Soc. Mech. Eng. on a portable accelerometer for railway testing. It may be used for securing direct readings of acceleration and retardation of moving cars and trains. The action of this instrument depends upon the inertia of a small mass of mercury contained in a horizontal passage, the ends of which are in communication with two short vertical columns of mercury. Thus the flow induced in the horizontal passage produces a difference of level in the vertical columns, which difference of level is wholly dependent of the horizontal component of the acceleration in the plane which passes through the axes of the two vertical columns. Upon this difference of level, or rather upon the change of level of either column from a given zero position, must depend the indication of the instrument. In a small instrument, however, this change of level is very small. Therefore, colored alcohol or other liquid of low specific gravity is introduced into the spaces above the mercury columns, to which spaces the reading tubes are connected. The reading tubes are of comparatively small diameter. Thus the ratio of the cross-section of the mercury column to the cross-section of the reading tube, become approximately the multiplier of the changes of mercury levels. The uper ends of the two reading tubes are connected so as to prevent evaporation and spilling of the liquids. The reading scale is provided with vertical adjustment to facilitate the proper location of the zero point. If the accelerometer be set to the zero position when the car is either at rest or moving uniformly on either a level or gradient, the indications will be accurate only as long as the car remains on a track of constant grade. When the grade changes, the accelerometer must be readjusted or the proper correction made. When the resetting cannot be done at the time of testing, it should be set at zero on a level track, and the car run over the road and brought to rest on all grades to be measured. In this way the instrument becomes a gradiometer. The instrument may be combined with a recording device; a record curve thus obtained is reproduced. A feature of the instrument is the accuracy with which it follows rapid changes without excessive and sometimes without perceptible, oscillation due to the inertia of the moving liquids. The best results are obtained when the cross-section of the passage at the bottom of the mercury columns is so proportioned as to give the proper damping effect. (In its principle the instrument is similar to that of Kapp. See Digest, Aug. 11, 18, 1900.)

REFERENCES.

Electric Car Equipments and Maintenance.—Wigram.—A long paper read before the Newcastle section of the (Brit.) Inst. of Elec. Eng. Under the heading car bodies he discusses the stairway, ventilation and details; he then describes the car equipment, trucks, brakes, sanding gear, life guards route indicators, motor equipment,

trolley heads, trolley standards and controllers. In conclusion, he deals with the maintenance of the cars.—Lond. *Elec. Eng.*, Dec. 27.

Mechanics of Electric Traction.—A summary of formulas showing the relation between the various principal mechanical factors in the movement of cars and trains.—*St. R'y Rev.*, Dec. 15.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Two-Wire and Three-Wire Systems.—A paper by Dean on the power plant of the Mass. General Hospital, of Boston, Mass. The electrical power is used for lighting 2000 incandescent lamps, for operating elevators, a refrigerating machine and various motors. There are two 100-kw and one 50-kw generator. The voltage is 220, and the wiring is on the two-wire system. As the exhaust steam is utilized during most of the year for heating, the extra steam consumption caused by the lower efficiency of the 220-volt lamps compared with 110-volt lamps is not a case of extravagant coal consumption. He says that the following considerations led him to the adoption of 220 volts: "The use of half as many generators as would be required by the three-wire, 110-volt system, with lower cost of installation and less cost of maintenance, etc.; a smaller engine room and, therefore, a less expensive building; a smaller building, which, considering the available space, was a very important feature; cheaper engines and cheaper foundations on account of extending for an outboard bearing only on one side; less expensive wiring." In the discussion which followed, Darling asked what objection could there have been to the use of a 110 or 120-volt, two-wire system. The only serious difference in cost would have been in the copper, and that would be met by the difference in efficiency of lamps during at least six months of the year when no heating is done and the exhaust is wasted. Katte said that for the 300-kw plant of the N. Y. Central & Hudson Railroad at Albany the 220-volt direct-current two-wire system was adopted. The important reason for this "was a consideration of the load diagrams, from which it was apparent that power units in multiple of 75 kw would give the most economical distribution of loads during each hour of the 24, both in summer and winter. It was further considered desirable to install machines of the same size, and thus render the plant more nearly interchangeable, hence had the 110-volt, three-wire system been adopted it would have required the installation of a large number of quite small machines of less efficiency, requiring more floor space and more attendance, which it was believed would fully offset the lower efficiency of the 220-volt lamps. In the West Shore Railroad plant at Weehawken the 220-volt, two-wire system is also used. Henshaw criticised Dean's statement that the use of half as many generators was one of the reasons for adopting the 220-volt, two-wire system. It is not at all necessary to use two generators for the three-wire systems. They may, for instance, be avoided by means of a small motor-dynamo. In regard to the economy of 220-volt lamps as compared with 110, he said that the best present commercial 110-volt lamps consumes about 3.1 watts per candle and the 220-volt lamp about 3.8. For an equal number of lights of the same illumination, one saves about 18.5 per cent in power by using the 110-volt lamp. Assuming a total of 1000 lights and an average illumination of four hours a day. for 365 days, and the cost of the kw-hour at 4 cents, there is an annual saving of about $654, which would be the interest on something like $10,000. Therefore, in such a plant about $10,000 must be saved on the original cost to make it pay to use the 220-volt lamp rather than the 110-volt lamps. Bolton referred to installations of 3000 or 4000 lamps in New York, put in on the two-wire, 240-volt system; but the reasons were that there was a specially large motor load, and it was desired to keep the whole system of one character to avoid complication. In another installation with 15,000 lights and a motor load of 100 kw, he uses the three-wire system for motives of economy. He mentioned the following difficulties in connection with 220 or 240-volt systems. The lamps are shorter lived and tender, and cannot be placed with impunity in all kinds of positions. Moreover, "there are so many apparatus of an exterior character which are sold nowadays, designed for use with 110 and 120 volts, which the tenants of a building will bring in and put on 220-volt circuits and break them, and will then charge the owner of the building with the cost."—*Transactions Am. Soc. Mech. Eng.*, v. 22, 1901.

Central Station Statistics for France.—SOULIER.—Twenty-nine full pages of statistical tables, giving in different columns, the name of the city or town, the population, the name of the company, the date of starting electrical supply, information about lighting, power, the capacity of the station, the capacity and type of the dynamos, the system used, further information about the distributing network, the rate of charging, etc. A summary of the statistics is not given, but the following general notes are added. In the mountain districts the number of central stations has largely increased. In the valley of Gresivandan there are 50 small towns around a station. Water power plants are found in Savoy, and in the Pyrenees. The city of Limoges is supplied with electricity from a hydraulic station at the falls of the Vezen River, 75 kilometer distant. There is a tendency to increase the direct-current supply voltage to 220. Many cities also use the 2-by-220-volt, three-wire system. The single and polyphase alternating-current systems have become more and more numerous. The three-phase system especially is often used. The transmission voltage of the three-phase plant of St. Georges is 20,000. The 5000-hp plant of St. Etienne distributes three-phase currents at 5000 volts over a manufacturing district, there being 4000 electric motors installed. The series distribution for public arc lighting disappears more and more. The price of electrical energy varies greatly, the limits being 10 and 20 cents per kw-hour. The use of meters becomes more and more general. Several cities have adopted the variable tariff of Brown and Routin.—*Supplement to L'Ind. Elec.*, Dec. 10.

San Jose.—An illustrated description of the system of the Electric Improvement Company, of San Jose, which is representative of recent methods of using steam auxiliaries in the distribution of transmitted power. There is a steam-driven, 400-kw, 2300-volt, three-phase generator which supplies current for the operation of the incandescent lighting and induction motor load, in parallel with transmitted power, while the arc lighting system is similarly supplied by three General Electric constant current transformers, each delivering alternating current for the operation of a series of 50 enclosed arc lamps of 2000 cp. The company holds a contract with the Standard Electric Company for the distribution of electrically transmitted power from the Standard lines in and about San Jose. The sub-station adjoins the power plant and contains 300-kw transformers, having primaries interchangeable from 40,000, 50,000 or 60,000 volts, and delivering 2300 or 4000 volts in star connection, two motor-generator sets of 150 and 200 kw and a storage battery of 270 cells. The motor-generators change three-phase current at 4000 volts into direct current at 550 volts for street railway and direct-current power service.—*Jour. of Elec.*, Nov.

Electric Light Costs and Charges.—An article giving some averages of electric light costs and charges in the Eastern, Middle, Southern and Western States. The summary for all States together is as follows: Lowest cost of coal, $1 per ton; highest cost, $6; average cost, $2.96; highest basic rate of charge, 20 cents per kw-hour; lowest minimum rate, 1 cent; average, 12.3 cents, while the average minimum charge to large consumers is 5.1 cents.—*Elec. Rev.*, Jan. 4.

REFERENCE.

Chicago.—JUNKERSFELD.—An illustrated article on central station expansion in Chicago. The kw-hour output of the two companies which carry on the supply of electrical energy has increased nearly 25 per cent last year. A description is given of the additions in plant.—*West. Elec.*, Jan. 4.

WIRES, WIRING AND CONDUITS.

REFERENCES.

Alternating-Current Transmission Lines.—STARTSMAN.—A long and chiefly mathematical article on the theory and calculation of alternating-current transmission lines. In a general introduction he notices the various factors which are liable to affect an alternating-current transmission line. He then deals at greater length with the determination of the four most important constants: The effective resistance, the effective reactance, the effective inductance due to leakage current, and the effective susceptance due to capacity. The calculation of a transmission line is then given by two methods. First, by the topographical method, and then by Steinmetz's symbolic method. The results are applied to the calculation of a special numerical case and to the construction of a mechanical model of a transmission line.—*Elec. Rev.*, Dec. 28.

Development of the Locke Insulator.—LOCKE.—An illustrated article on the gradual development of his glass and porcelain insulators up to the types used in the systems of the Standard Elec. Co. and the Bay Counties Power Co.—*Jour. of Elec.*, Nov.

ELECTRO-PHYSICS AND MAGNETISM.

Electrical Resonance and the Coherer.—KIEBITZ.—In his investigations of the electric oscillations of a straight conductor, he made the observation that a coherer acts most readily when connected up with two wires parallel to the exciter wires, and when the length of the wires attached to the coherer is that of a quarter-wave length each. Hence the coherer shows the maximum action in the node of potential. Slaby, on the other hand, found the explanation of his system of multiplex space telegraphy upon the opposite assumption, that the coherer is best placed in a neutral segment of the variation of potential. The present author has, therefore, extended his observations and confirmed his former result. It is evident that the coherer will give the best indications when the greatest possible difference of potential is produced at its ends. Now, if the cohorer acted as an insulator of very small capacity, the best arrangement would be to attach wires of a length equal to half a wave-length. But if the capacity of the coherer is very great, or if the coherer acts as a conductor, there must be resonance when the length of the attached waves is equal to a quarter-wave length, and this arrangement would be most favorable when placed at the node, although there may then be a minimum potential difference at the ends of the coherer. He concludes, therefore, that the coherer acts as a great capacity or as a conductor. It probably acts as the former in its original state, and as the latter after the impact of the waves. He used coherers made of iron screws.—*Ann. der Physik,* No. 12; abstracted in Lond. *Elec.,* Dec. 27.

X-Light.—ROLLINS.—A continuation of his very long serial in which he gives three different notes. In the first he describes an experiment which seems adverse to the theory that X-light is a flight of particles. The second deals with photographic results with X-light, specially with arrangements for making photographs with a practically instantaneous exposure. The third note refers to the sources of the cathode stream. He describes the following experiment: The cathode of an X-light tube was placed in a glass receptacle with an opening toward the target, which was only large enough to allow the stream to pass through it. When the gases from the cathode had been removed by heat and heavy surges, the tube was of no practical use as a source of X-light, for the free circulation of the gases had been interfered with and the cathode stream had had no time to recuperate.—*Elec. Rev.,* Dec. 28. Another continuation of his serial, dealing with the importance of lowering the initial resistance of an X-light tube.—*Elec. Rev.,* Jan. 4.

ELECTRO-CHEMISTRY AND BATTERIES.

Manufacture of Metallic Sodium.—DARLING.—After a brief account of the former sodium methods, he describes his electrolytic method of making metallic sodium and nitric acid from fused natural, sodium nitrate. The process is used by Harrison Brothers & Co. in Philadelphia, in a 12-cell plant, capable of decomposing from 700 to 800 lbs. of nitrate per day. The first experiments made by him showed the necessity of separating the reduced metallic sodium from the nitrate. This made the use of a diaphragm cell an absolute necessity. A satisfactory diaphragm is a granular body of vitrified magnesium oxide, confined between the walls of perforated sheet iron. This was made by fusing pure magnesium oxide to a vitreous mass in an electric furnace, grinding it and pressing it into a round cup having double walls of perforated sheet steel. As the first cost of the electrically fused magnesia filling for the cup was very high, a cheaper material was looked for and found in a mixture of ground, dead-burned magnesite and Portland cement. The construction of the total cell is as follows: A cast-iron pot set in a brick furnace to contain the nitrate to be decomposed also acts as anode. A 6-inch layer of refractory insulating material is placed in the bottom of the pot, and the porous cup rests centrally on it, leaving a 3-inch space between the cup and the bottom. This space is then filled with sodium nitrate, and the cup itself is nearly filled with melted sodium hydroxide. The cathode consists of a short length of 4-inch wrought iron pipe and is suspended inside the cup, reaching nearly to the bottom. When external heat is applied, the electrolytes melt. When current is passed through the cell, sodium is liberated at the cathode, it rises to the top of the cup and is dipped off with a spoon. At the anode, nitrogen dioxide and oxide are liberated as gases. They are conducted through pipes to a number of receivers or Woulff bottles, containing water; the gases combine with the water and form nitric acid, as a valuable by-product of the process. Each cell takes a current of about 400 amperes at 15 volts. External heat is used only when starting up and when charging the cups which have a life of 425 to 450 hours. At first the perforated sheet steel walls had a very short life, being quickly eaten away by local action caused by the secondary effects of the current. This trouble was overcome by shunting about 5 per cent of the current directly through the metal walls of the cup, making them secondary anodes. This has increased the life of the cup about tenfold. He discusses the use of sodium for making sodium peroxide and for making cyanides.—The same number contains the official report of a special committee of the Franklin Inst. on Darling's invention, for which the John Scott Medal has been awarded to him.—*Frank. Inst.,* Jan.

Aluminum.—MORRIS.—A long abstract of a paper read before the (Brit.) Inst. Elec. Eng., on "Aluminum, notes on its production, properties, and use." He describes the only British aluminum plant which is at Foyers and utilizes water power, there being seven turbines, direct coupled to 700-hp, direct-current generators. All the processes for aluminum production now at work, consist in the reduction of alumina. Other compounds of the metal offer great inducements, notably the chloride and sulphide, their voltages of decomposition, 2.3 and 0.9, respectively, being lower than that of alumina, which is 2.8; unfortunately, however, the two former compounds are difficult and expensive to produce. A description is given of the electrolytic methods of Heroult and Hall. The present world's output of aluminum is estimated at something over 5000 tons per year, whereas the yearly output of the metals with which it chiefly competes—namely, copper and tin—is about 497,000 tons and 79,200 tons, respectively. The properties of aluminum are described. Sheets can be hammered down to 0.000025 inch thick, in consequence of which it has largely replaced silver leaf, and wire can be drawn down to 0.004 inch. According to Wilson's, aluminum 99.55 per cent pure, has a specific resistance of 0.000002762 legal ohms per cubic cm., at 15 degs. C., with a temperature coefficient of 0.00393 per deg. C. The following comparison of copper and aluminum wires is given, the first number always referring to copper wire, the second to aluminum wire: Specific gravity, 8.93 to 2.65; conductivity, 100 to 61; section for equal conductivity, 1 to 1.64; diamter for equal conductivity, 1 to 1.28; weight for equal conductivity, 1 to 0.485; weight for equal section, 1 to 0.297; tensile strength for equal section, 1 to 0.46; tensile strength for equal conductivity, 1 to 0.75. He advocates the use of aluminum wires, especially for high-tension transmission.—Lond. *Elec. Eng.,* Dec. 20.

REFERENCE.

Aluminum.—WILSON.—An abstract of his recent (Brit.) Inst. Elec. Eng. paper in which he gives several very valuable tables, which are reproduced. The first table gives the tests of commercially pure aluminum, two other tables give the tests of various aluminum alloys. —Lond. *Elec. Rev.,* Dev. 27.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Electrometers.—DUANE.—In most symmetrical electrometers, such as the quadrant, the needle or movable conductor is made of different material from that of the fixed conductors. It is important in such cases to determine the effect, if there is one, of the e. m. f. existing between two metals in contact with each other, or, more strictly speaking, of the difference in potential between two points in the air just outside the two metals in contact, respectively. He has found both theoretically and experimentally that the Volta contact e. m. f. under certain very common experimental conditions, may introduce a large error into the measurement of a potential difference. He has also found that if the needle is suspended on a metal wire by means of which it is charged, and if the instrument is used idiostatically the quadrant electrometer can be used to measure the Volta e. m. f. with great accuracy. The paper is largely mathematical, and cannot well be abstracted.—*Phys. Rev.,* Dec.

A Low-Temperature Thermometer.—PELLAT.—A description of a low-temperature thermometer, based upon the Peltier effect. He uses an iron-zinc couple on account of its great thermo-electric power at low temperatures. The part to be exposed to the low temperature has the shape of a cylindrical bar about 20 cm. or 30 cm. long, with a junction in the middle. This bar is enclosed in a glass tube and brought into the space whose temperature is to be measured. A current is sent through sufficient to produce a measurable Peltier effect, but no perceptible Joulean heat, and its direction is such as to produce a cooling of the junction, and this cooling is compen-

sated by heat supplied by a small heating coil, so that the resulting difference of temperature, as indicated by two auxiliary thermo-couples, becomes zero. He gives the theory of the instrument, and shows that at an absolute temperature of 20 degs. the error would not exceed 1.5 degs.—*Comptes Rendus,* Dec. 2; abstracted in Lond. *Elec.,* Dec. 27.

REFERENCE.

Acceleromcter.—See the abstract under Traction.

TELEGRAPHY. TELEPHONY AND SIGNALS.

REFERENCES.

Johnstown.—An illustrated article on the development of independent telephony in Johnstown, Pa.—*West. Elec.,* Jan. 4.

Wireless Telegraphy.—MAVER.—An illustrated article on the past and present status of wireless telegraphy and its prospects.—*Cassier's Mag.,* Jan.

MISCELLANEOUS.

REFERENCES.

Alloys as Solutions.—MATHEWS.—The first part of a very long illustrated summary. After a historical introduction the following subjects are dealt with: Crystalline growth of metals, the effect of strain, freezing point of metals, binary alloys, solid solutions, behavior of binary alloys during cooling from the fused state.—*Eng. and Min. Jour.,* Dec. 21.

Glasgow Exhibition.—BATHURST.—A continuation of the illustrated serial on machine tools at the Glasgow Exhibition, with special reference to the requirements of dynamo and motor manufacturers. The present part deals with grinding machines and planing machines.—Lond. *Elec. Rev.,* Dec. 27.

Electrical Progress.—ALDRICH.—An article on electrical progress in the United States in 1901, giving condensed notes on the Edison battery, the Nernst lamp, and progress in distributing systems, electric traction, and power transmissions.—*West. Elec.,* Jan. 4.

Wheeler.—DUNN.—A biographical sketch of Schuyler Skatts Wheeler, with a portrait.—*Cassier's Mag.,* Jan.

New Books.

HOW TO BUILD A THREE-HORSE-POWER LAUNCH ENGINE. With a Full Set of Working Drawings and Explanatory Text. By E. W. Roberts, M. E. Cincinnati, Ohio: The Gas Engine Publishing Company. 66 pages, illustrated. Price, $2.50.

The author's purpose in writing this work was to give absolutely all the information required by an ordinarily intelligent mechanic, to enable him to construct the engine named in the title. The subject is treated in an eminently practical manner, giving detailed instructions for the manufacture of each part. One of the principal features of the book is the complete set of working drawings. There are 14 sheets of these drawings, and the size, 10 by 12½ inches, has been adopted for the page, for their accommodation. The drawings are for the most part complete and accurate. There is, however, one omission noted in the text on page 6. and we think the clearness of the drawings would be greatly increased and their value enhanced by the use of shade lines at the bottom and right of all solid parts and at the top and left of all openings. For the accommodation of those who wish working drawings on a larger scale, the publishers state they will furnish blue prints of the original drawings for a moderate price.

The author contends that an engine of the four-cycle type is easier for an amateur to construct than is one of the two-cycle type; he therefore, chose the former for his subject. The engine has been designed with especial reference to building it with small tools. No piece, except the flywheel, which is 18 inches in diameter, requires a lathe swing of over 16 inches, and the cylinder and base are cast separately to facilitate machining, although the total amount of machining is somewhat increased thereby.

Nothing but practical information is contained in this volume, and the reader is referred for all theoretical and even some descriptive matter to the author's "The Gas Engine Handbook."

BOOKS RECEIVED.

ELEKTRO INGENIEUR KALENDER, 1902. By Arthur H. Hirsch and Franz Wilking. Berlin: Oscar Coblentz. 209 pages. Price, 2.50 marks.

A SCHOOL CHEMISTRY. By John Waddell, B. A. (Dal. Coll.), B. S. (Lond.), Ph.D. (Heidelberg), D. Sc. (Edin.). New York: The Macmillan Company. 278 pages, 90 illustrations. Price, 90 cents.

ANNUAIRE POUR L'AN 1902. Publié par le Bureau des Longitudes. Paris: Gauthier-Villars. 656 pages. Price, 1.50 francs.

Novel System of Decorative and Sign Lighting.

Among the recent developments in electrical lighting, to which we called attention on its preliminary introduction here, is the "Elblight" system, which is controlled by the National Electric Improvement Company, of New York. The fundamental principle covered by the system consists in obtaining for incandescent lamps electrical contact by the insertion of pin terminals on the lamps connecting through a self-healing insulating medium into an easily perforated electrical conductor. One form of this system consists in display signs. These display signs—or, as they are called, electric lighting boards—are made up of a number of parallel conductors, properly insulated with a special compound, and the surface then covered with a specially treated cork carpet. When finished this board looks like a cork mat. At any point where a lamp is stuck in on this board, the lamp will engage the two sides of the electric conductor and derive current. It can be readily seen that on this cork surface, therefore, any lettering or design whatsoever can be made, and then outlined with electric bulbs of different sizes, shapes and colors to suit the fancy of the

FIG. I.—BANQUET ROOM DECORATION.

artist or consumer. The board can be used indefinitely, and the designs or lettering on it can be varied rapidly without any expense beyond that of the time consumed in drawing the lamps out from one place and sticking them into another. This is done with the same ease that a pin is inserted into a pincushion.

Another form of the apparatus made by the National Electric Improvement Company consists in a twin cable. This cable is made up of 300 fine wires that form an aggregate carrying capacity equal to that of a No. 5 B. & S. gauge wire. These fine wires are braided in a peculiar manner which gives the cable great flexibility and permits the free insertion of pin terminals without causing any disruption in the fine strands.

The cable is insulated with a very high grade of rubber compound, such as is used in the United States Navy, and after submersion in water for 48 hours withstands a breakdown pressure of more than 8000 volts. On the galvanometer it shows a resistance of 800 megohms to the mile. It can be twisted and turned into any shape. The ease with which the lamps can be inserted and withdrawn permits the decorative artist to obtain exactly and at once the effects he desires. The company make a special base for their lamps in connection with their cable to preclude any possibility of short circuit, and which renders it possible for the lamps to burn under salt water.

Two notable illustrations of the use of this system are now to be seen in New York City. One is the illumination of the Crystal Palace in the play, "The Sleeping Beauty and the Beast," which is running at the Broadway Theatre. This palace, which was made in Vienna for the Drury Lane Theatre, of London, is composed of 33,000 pieces of crystal. It was sent from Vienna to London where it met with

great success. The palace was then dismantled and shipped to this country and re-erected by Messrs. Klaw & Erlanger for the Broadway Theater. The requirements were that 2,000 lamps were to be put in this Crystal Palace, and the question arose as to how such a thing was possible with the old system. The question was speedily settled, however, by the use of the "Elblight" method. This system was installed and put in operation in three days, 2000 ft. of cable and 2000 4-cp lamps being installed. The play has been running daily since Nov. 4, and the management of the theater say that it is the only part of their electrical installation that has not required any care or attention or given any trouble.

The other illustration of the use of this system was to be seen quite recently in the palm garden of Pabst in Harlem, where 2000

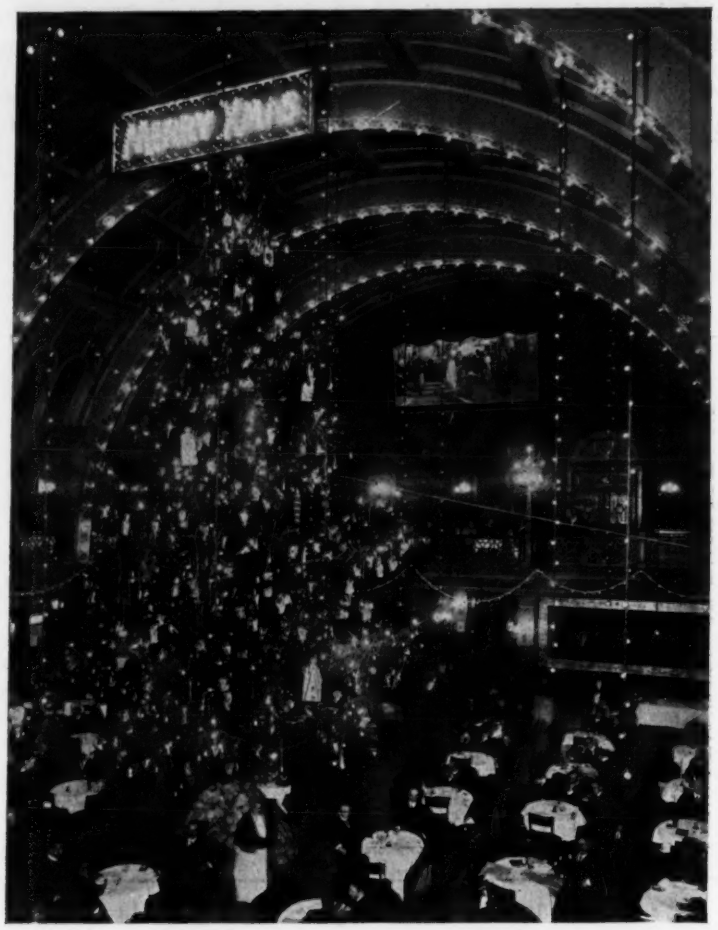


FIG. 2.—CHRISTMAS TREE DECORATIONS.

lights were installed by four men in three days. In the center of the Garden a Christmas tree 55 ft. in height rose to the arched girders. This tree contains 300 4-cp lamps. Directly over it there hung an electric lighting board, 4 ft. wide and 12 ft. long, on each side of which were written the words, "Merry Xmas." The board in all contained 400 lamps, part of these lamps being colored and forming a border around the legend. From 20 different points of the various arches hang straight streamers 32 ft. in length, each streamer containing 32 lamps of different colors, the end of each streamer terminating in a spherical frosted bulb.

Renold "Silent Chain" Transmission Gear.

Among the latest plants to be erected at Niagara Falls is that of the Natural Food Company, makers of shreded wheat biscuit. The plant is driven throughout by induction motors and the power is transmitted to the machines by means of the Renold "silent chain" gear. The several views shown herewith illustrate the convenience and flexibility of this new method of power transmission. The drives vary in size from 1 to 40 hp, and there are nearly 40 of them.

The Renold chain, which furnished the subject of a paper read at the recent meeting of the American Society of Mechanical Engineers, automatically assumes its proper place on the wheel, thus distributing the load equally between all the teeth in mesh. As the chain elongates from use it takes a position farther and farther out on the wheel teeth, forming a larger pitch circle, exactly proportional to the increased pitch. In this way the initial perfection of action, which is lost in the ordinary chain as soon as the gear is started up, is in this case present to the very last.

Each link of the chain comes to its seat by a rolling action, and there is none of the sliding up and down the tooth, which is so

FIG. 1.—"SILENT CHAIN" TRANSMISSION GEAR.

destructive to both chain and sprocket. The action of the chain is shown by Fig. 1. The upper illustration shows the meshing when the chain is new, the one beneath when the chain has lengthened, .6 inch per foot, and the lower illustration shows the action of the chain in coming on and leaving the wheel.

The advantages of chain driving in general are that it has an absolutely fixed velocity ratio, unlike a belt, which will slip more or less. It minimizes loss in journal friction, since the chain does not depend on its tension for its adhesion to a sprocket as a belt does on a pulley; hence the chain is run loose and the only pressure on the journal is that necessary to the performance of useful work. Finally, it is especially adapted to damp and hot places where a belt cannot be used.

The particular advantages of the Renold chain are its unique properties of absolutely silent running and of high speed possibilities.

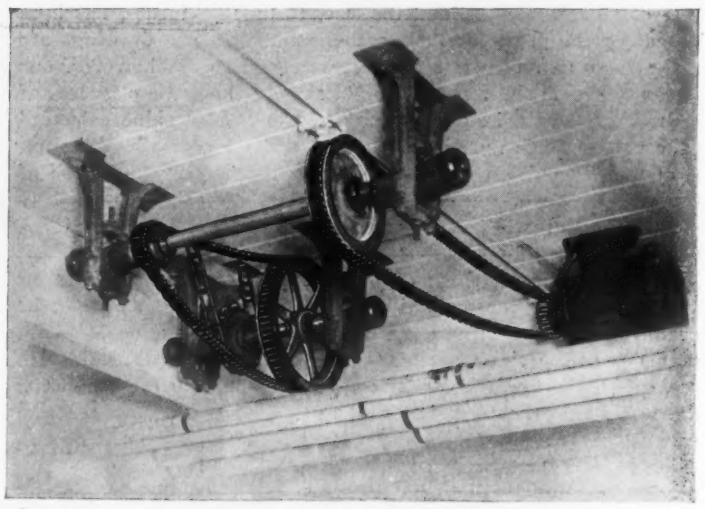


FIG. 2.—"SILENT CHAIN" TRANSMISSION GEAR.

The strength of the chain may be increased indefinitely by increasing the width and without increasing the pitch. This means that the wheel sizes are also kept within limits. A worn chain has the same perfect action of a new one, because it automatically adapts itself to the sprocket. When a chain becomes too wide for convenience in manufacture or in handling, two chains may be run side

by side, and because of the fact that each chain automatically adjusts itself to its sprocket, each chain will bear its proper share of the load. The wear from jarring action when a link passes out of mesh, which has been an objection to ordinary chain drives, and which has limited heretofore the speed of chain driving, is eliminated in the Renold chain, as implied in its noiseless action.

The high speed possibilities of Renold chain make the transmission of power from motors one of its most important uses, and as an evidence of its durability it is stated that a motor car ran 30,000

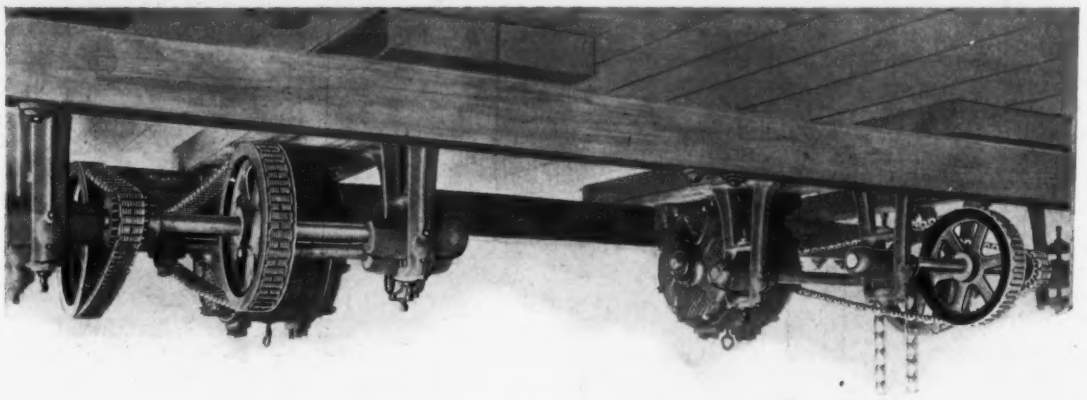


FIG. 3.—"SILENT CHAIN" TRANSMISSION GEAR.

miles and more with a chain of this type, which was in good order and entirely serviceable after this performance. The normal speed of the chain in this instance was 2000 ft. per minute.

Another point of special importance in connection with the Renold's chain for electrical drives is its adaptability to short centers. In this respect it approaches spur-gearing; in other words, approximates to the direct-connection, which in electrical generation has become the rule through the vast saving of space entailed. The use of short centers with this type of gear follows from the high speed at which it can operate, owing to its smoothness of action, which results from every tooth in mesh being in equal contact with the chain, and which continues, regardless of wear or stretch. It goes without saying that this action leads also to a long life of both the chain and sprocket.

The illustrations shown of the Natural Food Company's plant are examples of the application of Renold chain to motor driving. The service is severe because of the sudden start and quick acceleration, under load, of the induction motors used.

The drives in the Natural Food Company's plant were installed by the Link-Belt Engineering Company, of Nicetown, Philadelphia, which, with the Link-Belt Engineering Company, of Chicago, directly control the application of the Renold silent chain to machines and engineering uses in this country. Mr. Hans Renold, of Manchester, England, is the inventor, and to him credit is due for its development into a practical and virtually perfect mechanical device.

Automatic Motor Starter.

The Acme solenoid automatic motor starter illustrated below is one of the latest productions of the Automatic Switch Company, of New York, and is designed to be used with motors that do not require the more expensive forms of motor-driven starters manufactured by this company.

Among the advantages of this starter may be mentioned the simplicity of its construction, which is obtained partially by the form of resistance, known as tubular resistance, and manufactured by this company in this form. The iron clad construction of both resistance and solenoid magnet, and the freedom from lack of adjustment due to placing a resistance arm directly on the head of the solenoid core (thereby doing away with the customary swinging arm), are features of special value. In addition to the above described advantages, attention is called to the patented method of winding the solenoid. There is a heavy coil in series with a fine coil. When the motor is started the fine coil is short circuited by a small switch shown at the top of the starter. This switch is opened after the resistance is completely cut out by the travel of the resistance arm, resulting in throwing the two coils in series with each other across the line. This greatly reduces the amount of current passing through the coils, and prevents overheating of the solenoid windings. This was accomplished by the insertion of a lamp resistance in many of the older forms of starters. The lamp was, however, found to be undesirable, owing to the fact that it was easily broken, or accidentally detached from its base.

The dimensions of the oil chamber of the oil dash-pot governor are of such ample proportions as to allow a very loose fit of the plunger, which avoids the possibility of dirt or grit interfering with the proper action of the governor. On the resistance arm graphite brushes are used, in conjunction with substantial final contacts of elastic copper, well adapted to carry the full-rated current of the motor.

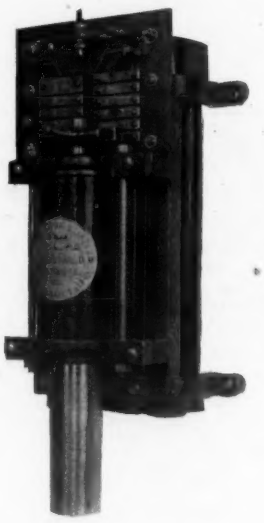


FIG. 1.—AUTOMATIC MOTOR STARTER.

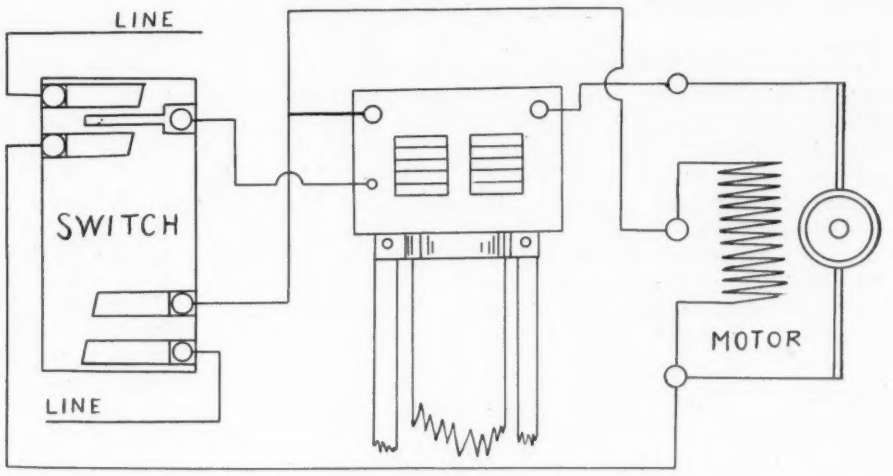


FIG. 2.—DIAGRAM OF MOTOR STARTER CONNECTIONS.

The diagram of connections illustrates the simplicity of wiring when used in connection with a double-pole quick-acting switch. This form of starter, it is stated, has proved very satisfactory in hevay service.

Automobile Endurance Test.

A severe endurance test of a Toledo steam vehicle is being planned by the automobile department of the American Bicycle Company. Mr. Oliver Lippincott, of Los Angeles, Calif., will make a tour of the West in one of these vehicles, making a circuit of the Grand Canyon of the Colorado, followed by journeys through the Yosemite Valley and Yellowstone Park, as well as other points of interest in and about the mountainous Western country.

The machine selected for this trip is a regular stock model, with

AUTOMOBILE FOR ENDURANCE TEST.

a few slight changes to increase the water-carrying capacity, etc. The total weight of the vehicle, ready for its long journey, including occupants and their baggage, will be 2150 lbs. A feature of the outfit is the trailer, which is shown in the accompanying illustration. This trailer will carry four extra gasoline tanks, an additional water tank, and an extra compartment for photographic material. The vehicle is of 7½ hp.

American Exposition in London.

Alfred H. Post, of Alfred H. Post & Co., foreign freight contractors of the Produce Exchange, New York City, who is the United States Commissioner for the exclusively American exposition, to be held in the London Crystal Palace from May to October, this year, in course of an interview with a representative of ELECTRICAL WORLD AND ENGINEER, said: "The complete success of the exposition, as far as regards an abundance of exhibits, is fully assured, applications having already been received for over 75 per cent of the available space, and promises made for considerably more than the rest. What is desired, however, is a truly representative exposition embracing all sorts of American manufactured goods, and to accomplish this end we can find plenty of room for manufacturers of machinery, etc., not covered in the applications now in hand.

"Applications have already been secured from the following firms: The General Electric Company, Babcock & Wilcox, Niles-Bement-Pond Company, Standard Oil Company, American Waltham Watch Company ,of Waltham, Mass.; the Fairbanks Company, American Soda Fountain Company, Standard Desk Company, of Herkimer, N. Y.; H. J. Heintz Company, of Pittsburg, Pa.; T. W. & C. B. Sheridan, M. G. Thompson & Co., of Buffalo, N. Y.; Johnson Die Press Company, Bissell Carpet Sweeper Company, of Grand Rapids, Mich.; Huyler's Candy & Confectionery Company; Zullers, Limited; Hygienic Optical Company, S. C. Moffat Company, S. S. Wenzell Machine Company, of Philadelphia, Pa.; Hallwood Cash Register Company, of Columbus, Ohio; Mutual Life Assurance Company, Fidelity & Deposit Company, of Baltimore, Md.; Davis, Allen & Co., Peabody & Co., Wedwell Lawn Mower Company, Wellman-Seaver Engineering Company, of Cleveland, Ohio; National Cash Register Company, of Dayton, Ohio; Twentieth Century Introduction Company, T. A. Edison, Jr., Chemical Company, William Simpson & Co., of Philadelphia, Pa., etc.

"Charles Churchill & Co., Limited; Buck & Hickman, John L. Sardy and other prominent handlers of American machine tools, etc., in the United Kingdom have also applied for space, which they intend to utilize for the purpose of exhibiting the products of the Ferracute Machine Company, Bridgeton, N. J.; the Millards Falls Company, Millards Falls, Mass.; F. E. Reed, Worcester, Mass.; Geometric Drill Company, of Westville, Conn.; L. S. Starrett Company, Athol, Mass.; Bullard Machine Tool Company, Bridgeport, Conn.; Morse Twist Drill & Machine Company, New Bedford, Mass.; Norton Emery Wheel Company, of Worcester, Mass.; Springfield Machine Tool Company, Springfield, Mass.; Builders' Iron & Foundry Company, Providence, R. I.; Porter & Johnson Company, Pawtucket, R. I.; Hendey Machine Company Torrington, Conn.; Cushman Chuck Company, Hartford, Conn.; Oster Manufacturing Company, Cleveland, Ohio; E. Horton & Son Company, of Windsor Locks, Conn.; Henry Disston Sons Company, of Philadelphia, Pa.; Armstrong Brothers Tool Company, Chicago, Ill.; Detrick & Harvey Company, Baltimore, Maryland; Charles Parker Company; Fulton Iron & Engineering Works, Detroit, Mich.; Hill, Clarke & Co., of Boston, Mass.; Becker-Brainard Milling Machine Company, Hyde Park, Mass.; Goodall, Pratt & Co., Greenfield, Mass.; Schultz Belting Company, St. Louis, Mo.; Railroad Supply Company of America, Chicago, Ill.; Warner & Swasey, Cleveland, Ohio; Brown & Sharpe Manufacturing Company, of Providence, R. I.; William Sellars & Co., of Philadelphia, Pa.; American Gas Furnace Company, of Elizabeth, N. J.; Westcott Chuck Company, of Niagara, N. Y.; C. E. Jennings; Seneca Falls Manufacturing Company, Seneca Falls, N. Y.; Clayton Air Compressor Works, Brooklyn, etc. In addition to the exhibits which will be made by their London agents many of these people have already signified their intention of making individual exhibits on a much larger scale than a collective display will permit of.

"The complete list of the American advisory committee of the exposition is now to hand, and contains the names of William J. Clark, foreign manager of the General Electric Company, R. W. Blackwell, of Robert W. Blackwell & Co., Limited; J. G. White, of J. G. White & Co.; Charles Churchill, of Charles Churchill & Co., Limited; J. Morgan Richards, manufacturing chemist; D. C. Haldeman, London manager of the Mutual Life Assurance Company, of New York; B. F. Stevens, of the United States Dispatch Agency; F. C. Van Duzer, manufacturing chemist; Frank E. Bliss, of the Anglo-American Oil Company, Limited; Thomas Clarke; R. Newton Crane, barrister-at-law; R. J. Davis, manufacturing chemist; J. Walter Earle, of the Remington Typewriter Company; Thomas L. Field, of the Angle-Saxon Shipping Company; E. Marshall Fox; Colonel Millard Hunsiker, of the Carnegie Steel Company; Frank W. Jones; James McDonald, of the Angle-American Oil Company, Limited; J. G. Meiggs, of Meiggs & Son, contractors for public works; Isaac Seligman, of the banking house of Seligman Brothers; William Hall Walker; A. Bedford, of the American Waltham Watch Company; W. J. Boller, of George Borgfeldt & Co.; F. A. Branion, Dr. F. J. Campbell, Colonel George Earl Church, Samuel G. B. Cock; W. D. Craven, cattle importer; Robert N. Fairbanks, of the Fairbanks Company; W. H. Fassett, manufacturing chemist's agents; Dr. G. W. Field, Charles T. Fox; L. H. De Friese, American lawyer; Henry S. Downe, of the American Radiator Company; J. W. Downer, of the National Tube Company; Thomas J. Farrell, of the American Steel & Wire Company; F. M. Fisk; Clark Harrison, of the United States Cast Iron Pipe & Foundry Company; Louis C. Hay, of the Burt & Bratt Lumber Company; Charles A. Knight, of Babcock & Wilcox; George S. Mahana, A. Parrish; F. C. Poisson, of Poisson & Co.; John L. Sardy; A. B. Scott, manufacturing chemist; Professor S. H. Short, technical director of the English Electric Manufacturing Company, Preston; F. J. Stevens, of Jerome & Co., Limited, and Irving G. Wills, of the Standard Desk Company, Limited.

"The London advisory committee comprises Sir Joseph Druisdale, Lord Mayor of London; the Duke of Sutherland, the Marquis of Tweedale, the Earl Grey, the Earl of Crewe, Viscount Duncannon, Sir Dudley Baines Forwood, Bart., Alderman Sir Frank Green, late Lord Mayor of the British metropolis; Sir Douglas Fox, formerly president of the British Institute of Civil Engineers; Sir Henry Irving, Winston Churchill, M. P., Ernest H. Forwood and Alderman Joseph Lawrence, M. P., president of the Edison Ore Milling Syndicate."

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money closed nominally at 5 per cent; time money was offered with comparative freedom in amount, but rates remain unchanged and are quite firmly held. The closing quotations are: 4½ per cent for 30 days to six months on first-class collateral, and 5 per cent for good mixed collateral. The stock market during the week was irregular, with a depressed tone. Professional operators furnished the activity, and public interest is lacking in speculation, though bonds and investment stocks are objects of a fair buying demand. The steel stocks have been sold by foreign and local speculative holders, these and Manhattan being among the most active securities dealt in. The rise in Manhattan to 140, it is said, was based, to some extent, on the idea that in consequence of the Fourth Avenue tunnel disaster the New York Central might make arrangements by which the Manhattan will handle part of its passenger traffic. The successful running of the test electric train on Thursday was also considered favorable to the property, although the rise in price was apparently the result of the manipulation by a pool. The industrials generally were neglected, and street railways were comparatively inactive, Brooklyn Rapid Transit closing at 66¾, a net loss of ⅛ point, and Metropolitan Street Railway at 163½, a net gain of ½ point. Manhattan Elevated closed 139⅛, a gain of 2⅛ points on the week's business, the number of shares sold being 267,690. Dullness prevailed in the rest of the electric list, only 1300 shares of General Electric being sold, the closing price being 281, a gain of 1 point. Westinghouse Electric, common, remains unchanged at 177, and the preferred closed at 180, a net loss of 2 points. Western Union dropped 1⅛ points, the closing price being 91¼. Other closing quotations are: American District Telegraph, 36, a net loss of 2 points; American Telegraph & Cable, 90½, a net loss of 4½ points, and Commercial Cable, 160. Following are the closing quotations on Tuesday, Jan. 14:

NEW YORK.

	Jan. 7.	Jan. 14.		Jan. 7.	Jan. 14.
American Tel. & Cable..	90	90	General Electric	279	276½
American Dist. Tel....	—	32½	General Carriage.....	1¼	1
Brooklyn Rapid Transit.	65⅞	63⅜	Hudson River Tel.....	100	100
Ches. & Pot. Telephone..	—	—	Metropolitan Street Ry..	162¾	160¼
Commercial Cable	155	155	N. E. Elec. Veh. Tran..	½	—
Electric Boat	24½	25½	N. Y. Elec. Veh. Tran..	12	12½
Electric Boat pfd.....	45	47	N. Y. & N. J. Tel.....	—	—
Electric Lead Reduc'n...	1¾	1¼	Tel. & Tel. Co. America	—	—
Electric Vehicle.....	2	2	Western Union Tel.....	91	90½
Electric Vehicle pfd....	4	4	West E. & M. Co.....	177	170
			West E. & M. Co., pfd..	—	—

BOSTON.

	Jan. 7.	Jan. 14.		Jan. 7.	Jan. 14.
Am. Tel. & Tel.....	161	159	Mexican Telephone	2	2
Cumberland Telephone..	—	—	New England Telephone.	137	*139
Edison Elec Illum.....	—	—	Westinghouse Elec.....	90	—
Erie Telephone.....	15⅝	19¼	Westinghouse Elec. pfd..	89¾	—
General Electric pfd....	—	—			

PHILADELPHIA.

	Jan. 7.	Jan. 14.		Jan. 7.	Jan. 14.
American Railways.....	44¾	44½	Phila. Traction	97¾	97
Electric Storage Battery.	62	60	Philadelphia Electric	4½	3⅜
Elec. Storage Batt'y pfd.	—	60	Pa. Electric Vehicle.....	—	¾
Elec. Co. of America....	6½	5¾	Pa. Elec. Veh. pfd.....	2½	2½

CHICAGO.

	Jan. 7.	Jan. 14.		Jan. 7.	Jan. 14.
Central Union Telephone.	—	—	National Carbon pfd.....	84	82½
Chicago Edison	—	163	Northwest Elev. com.....	39¾	38
Chicago City Ry.....188		188	Union Traction.....	10½	10
Chicago Telep. Co.....230		—	Union Traction pfd.....	—	47
National Carbon.....	19	18¼			

*Asked.

CONSOLIDATED LIGHTING & REFRIGERATING.—At a meeting of the board of directors of the Consolidated Railway Lighting & Refrigerating Company, Mr. S. Marsh Young (formerly of the Hall Signal Company, and more lately of the Manhattan Arc Light interests of the Westinghouse Company) was elected vice-president and general manager of the company, and also director. Mr. George Dixon, identified with the United Fruit Company and the Columbus & Hocking Coal & Iron Company, was elected a director. The differences between the board of directors of the Consolidated Railway, Electric Lighting & Refrigerating Company and Isaac L. Rice, the president of the company, which resulted the other day in the board asking for Mr. Rice's resignation, reached another stage last week. The board passed a resolution in the presence of Mr. Rice, demanding "that he transfer and deliver to the said Consolidated Railway, Electric Lighting & Equipment Company forthwith 10,000 shares of stock of this company, which he received at or about the time of the proposition of March 27, 1901, of this company to stockholders of said Consolidated Railway, Electric Lighting & Equipment Company for the purchase of their stock, and which he then received, not under the terms of said proposition or in exchange for any stock of the said Consolidated Railway, Electric Lighting & Equipment Company, but contrary to equity and good conscience." When Mr. Rice was seen in regard to this action, he said that he had been present at the meeting and that the resolution was merely one of a series of steps on the part of F. C. Hollins to obtain control of the funds in the treasury of the company for purposes of which Mr. Rice does not approve, and among which, Mr. Rice said, was the purchase of a bankrupt natural ice car company. Mr. Rice, after reviewing the history of the company and the action that he had taken in regard to its management, added: "I hold only 5500 shares, and these were given to me by the former majority interests in the refrigerator company in lieu of salary, which latter I declined to accept until a time when the shares might be paying a dividend. These shares which I hold are not for sale."

NEW YORK TRANSPORTATION.—At the meeting of stockholders of the New York Electric Vehicle Transportation Company it was voted to reduce the capital stock of the company from $25,000,000 to $5,000,000, and to reduce the par value of the shares from $100 each to $20. It was also voted to change the name of the company to the New York Transportation Company. President Sanderson said: "The company has on hand $1,046,000. The gross earnings for November were $52,000, and the net earnings $16,000. The returns for December will be still better, and the prospects for a good business from now on are encouraging. It will take probably a year to get the express business fairly established. The intention is to increase the number of electric stage coaches on Fifth Avenue and get them running on regular schedule time." The number of shares represented at the meeting was 165,716.

NEW ORLEANS TROLLEYS.—Notice has been given that the Eastern syndicate which proposes to lease the New Orleans City Railway is ready to act at once. The syndicate has the option to purchase the stock at 35, meantime agreeing to pay $2 per share thereon until 1905, and then $3 per share until 1907. Six per cent is guaranteed on the preferred stock. About 50,000 out of 75,000 shares are controlled by the Louisville pool.

RAILWAY BOND COMPANY.—The American Street Railways Bonding Company has been incorporated at Trenton, with a capital stock of $500,000. The incorporators are Warren Dixon, Jersey City; E. Tibbits and Henry V. Brandenburg, of New York City. The company will acquire and hold as investment bonds or other securities and shares of capital stock of corporations.

LAKE SHORE ELECTRIC RECEIVER.—The properties forming the Lake Shore Electric Railway Company, controlled by the Everett-Moore syndicate, have been placed in the hands of a receiver—Albion E. Lang, president of the Toledo Railways & Light Company. That action was taken with the knowledge and acquiescence of the bankers' committee of seven.

DIVIDENDS.—The Standard Underground Cable Company, at Pittsburg, has declared the usual quarterly dividend of 2 per cent, and an extra dividend of 2 per cent out of the earnings of the year, payable Jan. 10. The directors of the Columbus Railway have declared the regular quarterly dividend of 1¼ per cent, payable Feb. 1.

ERIE TELEPHONE.—Over 90 per cent of the shares of the Erie Telephone Company, and over 75 per cent of all the bond issues have been deposited under the reorganization plan. The time for receiving deposits has been extended until 2 o'clock Jan. 15.

EVERETT-MOORE.—Over 70 per cent of all the creditors of the Everett-Moore syndicate have now given their assent to the extension of time asked for. This includes both traction and telephone interests.

CINCINNATI ELECTRIC.—Stockholders of the Cincinnati Gas & Electric Company have voted to increase capital stock from $28,000,000 to $29,000,000, the new stock to be available for improvements.

Commercial Intelligence.

THE WEEK IN TRADE.—The advices received by the mercantile agencies exhibited some irregularity due to the weather conditions, or proceeding from the early stage of the season. Stock-taking is now completed, and jobbers are anticipating an active spring business, of which considerable has already been booked. Speculation is likewise exhibiting a broadening tendency, but here also some irregularity is manifested, owing to counter currents and technical market conditions. The industries in the main continue active, iron and

steel setting the pace. The production of the latter is active beyond precedent for this season of the year. The car shortage still continues, although a change for the better is reported. The American rail mills are so crowded with orders that a contract for 105,000 tons for Mexico went to England last week, no American bid being received. Copper, though ostensibly held at 12 cents per pound, has been openly cut, and further reductions are looked for. The business failures for the week, as reported by *Bradstreet's*, numbered 346, as against 270 the week previous, and 322 the same week last year.

WORK IN COSTA RICA.—At a meeting in London of the Costa Rica Electric Light & Traction Company, Limited, President W. F. Leese said there had been a considerable and progressive business done. Two years ago they made £3,800, last year they made £6,800, and this year they had made practically £9,000. They considered from the first that the working capital of £10,000 would very shortly be encroached upon, because, although there was an equipment of the tramway, still there were no spare parts or duplicate machinery in case of a breakdown. In order to comply with the urgent demand for more light and tramway accommodation, certain extensions were carried out. There had been an increase in the business all round. Last year the connections increased from the equivalent of 4951 to 6896 16-cp lamps. The number of passengers carried during the year was 687,616, an increase of 37 per cent. Since the close of the financial year 2½ miles of additional tramway had been opened. With regard to the business itself, it necessarily had not been large, because they had not been able to fully comply with the active demand for light, power and traction. The profit of £9,000 roughly represented over 40 per cent of the total business done. As a matter of fact, they had only touched the mere fringe of the business. In the central valley of Costa Rica there were some 200,000 inhabitants who were all demanding the light and power, and an extension of the tramway. Owing to the nature of the country, the question of providing cheap locomotion and light was one which affected the interest of all the inhabitants. Their company started three years ago to supply those facilities, and it had done so to the best of its ability to the limit of its capital on the one side and its water concessions on the other. Those water concessions represented about 1000 hp. Recently they had a succession of droughts, and the consequence was that during the last two years, and more especially during the past dry season, they had not had sufficient water power for actual requirements. Their tram cars had been standing still during some hours in the evenings for weeks at a time, because they were not able to supply electrical energy to them, and at the same time to comply with their lighting obligations. Luckily, about that time Mr. Boza, who has had an electric lighting plant, from which he supplied the towns of Heredia and Alajuela, obtained the contract for lighting a portion of the street lamps in San Jose. That was the least lucrative portion of their business, and Mr. Boza had unwittingly done them considerable service in taking it off their hands at that particular crisis. The question of further water power had become acute, and it was absolutely necessary for them to consider without delay the advisability of a considerable expansion in that direction. They had put before them a scheme which would enable them to comply with all their obligations for many years to come. The new isthmian canal would probably enable the undoubtedly great resources of Costa Rica to be thoroughly developed, and would have an important influence both on its population and on its wealth.

CONTRACTS FOR THE LARGEST LIGHTING PLANT IN NEW YORK CITY.—R. H. Macy & Co.'s new store, which is now under construction at Broadway and Thirty-fifth Street, New York City, is to be installed with the largest private electric lighting plant in New York City. The plant will have a capacity of 2000 kw, entirely for lighting purposes, as but a very small portion of it will be called into requisition for operating the ventilating apparatus, pneumatic cash carrier system and some small pumping equipments. The elevators to be installed in the building will be worked by hydraulic power. The generators, consisting of four direct-current, 110-volt direct-connected machines of 400 kw each, and two equipments of a similar description, having a capacity of 200 kw each, have been ordered from the Western Electric Company, of New York City. The contract for the engines intended to drive the larger generators calls for Rice-Sargent machines, four compound Corliss type slow-speed, 100 r. p. m., having a nominal capacity of 600 hp each. They will be built at the Providence Engineering Works, of Providence, R. I. The engines for operating the two 200-kw generators will also be of Corliss type single-valve, of 320 hp each. These, however, have not yet been contracted for, nor have the 1500 arc lamps and 6000 incandescent lamps of 16 cp each, which will be required. The contracts for the equipment are being handled by Mr. Comstock, head of the electrical department of the George A. Fuller Company, 137 Broadway, which concern is constructing and equipping the building, in conjunction with Mr. C. O. Mailloux, the electrical engineer of the R. H. Macy Company. The switchboard material will be purchased by the Fuller people, who intend to complete its erection themselves. They will also do the whole of the requisite wiring. The boiler equipment is to be 2600 hp, comprising four batteries of 500 hp each, and two batteries of 300 hp each. This contract has been undertaken by the Babcock & Wilcox Company, of New York City. The pumping equipments are to be of Laidlaw-Dunn Gordon type, the contract having been allotted to the International Pump Company, of New York City. Mr. Quay, the Fuller Company's chief mechanical engineer, in concurrence with Mr. Reginald P. Bolton, the Macy mechanical expert, placed these contracts. A crematory, which is to be utilized for burning all the refuse, etc., in the new store, is to be built between two batteries of the larger boilers, so that the gas it burns while in operation can be used to advantage by way of aiding the boiler heat. The electric plant—which it is expected will be completely installed by Aug. 1—will represent an expenditure of nearly $300,000.

IMPORTANT AUSTRALIAN CONTRACTS.—The central power station of Sydney City & Suburban Tramways, of Sydney, Australia, the initial equipment for which contracts to the extent of over $1,000,000, have already been placed in this country, is to be considerably extended in capacity, and specifications representing an expenditure of some $500,000 have been issued. It will be recalled that when Mr. Charles Oliver, the chief railroad commissioner of the New South Wales Government, which is constructing the Sydney electric traction system, was in the United States in August, 1900, he placed a contract valued at almost $800,000 for the complete equipment of a plant having a nominal capacity of 4500 hp. This equipment, the last of which has just been shipped from this side, consists principally of three 1500-kw General Electric generators; three direct-connected 32 by 64 by 60 vertical cross-compound engines, built at the Allis plant at Milwaukee, and some $100,000 worth of piping, etc., from the Best Manufacturing Company, of Pittsburg, Pa. Prior to the letting of this contract, the Sydney power house was installed with four 850-kw General Electric generators, and Allis horizontal engines of 850 hp nominal capacity. Up to date, therefore, contracts have been let for a plant of 7900 hp nominal capacity. The specifications now requisitioned for are additional equipment of 6000 hp. The boiler plant already installed represents 8000 hp, there being 32 units of 250 hp each. These boilers are water tube ones, of Babcock & Wilcox build. The specifications now ask for 24 additional boilers. The entire plant will, therefore, have a capacity of 14,000 hp. The contract for the steel construction of the power house, which called for some 1200 tons of structural steel, was undertaken by the American Bridge Company. It was the first contract ever awarded for a steel structure in the Antipodes. The power house will be extended shortly. Besides the important installation before mentioned, everything required in the construction of the Sydney system other than the car bodies, which are being built in Australia, owing to the cheapness of wood in that part of the world, will be purchased in the United States, and before the entire system is an accomplished fact some $3,500,000 will have been expended.

STREET RAILWAY PRICES WANTED.—Mr. Joseph Ullo, of 1046 Eighty-third Street, Brooklyn, is desirous to secure catalogues, prices, etc., for electric railway equipment. It is reported that his principals are about to obtain a concession for the construction of a double-track road some 40 miles in length in the south of France. American capital, it is said, has already been secured, and American equipment will be utilized exclusively. The major portion of the route proposed to be traversed is already operated by horse tramways, which will be converted into electric motive power. Mr. Ullo's people anticipate an expenditure of some $200,000 in equipment, etc.

THE BREMER ARC LAMP, which has been described from time to time in these pages, and which uses special carbons carrying metallic salts, etc., and has special features of regulation, has been brought to this country, and is now in the hands of the Westinghouse Company, which has always shown such a progressive policy as to electrical novelties of importance. It is broadly understood that colored lighting effects obtainable are one of the features. We are not informed as to the control of the device in the United States, but it has been studied with much interest by those who have seen it in the Westinghouse offices.

BRILL TRUCKS FOR ENGLISH ROAD.—The J. G. Brill Company, of Philadelphia, is about to make a substantial shipment of trucks which are to be utilized on the Warrington (England) electric traction system, the contract for the construction of which was secured by the British Thomson-Houston Company, Limited, now controlled by the General Electric Company. Mr. Curwen, the European representative of the J. G. Brill Company, of Philadelphia, whose headquarters are in London, is now on a visit to the United States.

CROSELMIRE PLATINUM.—Mr. Croselmire, Newark, N. J., has sold his business to a new company, which will be styled Charles F. Croselmire Company , American Platinum Works, Charles Engelhard, general manager. The latter is well known in the platinum business, and will push actively the old enterprise under the new conditions and the long name, which is quite striking.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Jan. 4, 1902: Antwerp—21 pkgs. material, $818. Argentine Republic—199 pkgs. material, $10,047. British West Indies—32 pkgs. copper wire, $1,570. British East Indies—115 pkgs. machinery, $1,680. Bremen—2 pkgs. material, $20. Bolton—2 pkgs. material, $375. Bristol—14 pkgs. machinery, $470. Cuba—22 pkgs. material, $915; wire, $45. Central America—3 pkgs. wire, $67; 9 pkgs. material, $599. Cardiff—12 pkgs. material, $679. Dutch West Indies—31 pkgs. material, $1,024. Ecuador—1 pkg. material, $26. Florence—17 pkgs. machinery, $500. Genoa—17 pkgs. material, $669. Glasgow—3 pkgs. material, $113. Hanover—2 pkgs. material, $59. Hamburg—19 pkgs. machinery, $450; 31 pkgs. material, $1,502. Havre—7 pkgs. machinery, $75; 4 pkgs. material, $327. Japan—3 pkgs. material, $305. Liverpool—55 pkgs. machinery, $3,692; 1267 pkgs. material, $6,650; 20 pkgs. wire, $424. London—70 pkgs. material, $4,202. Mexico—88 pkgs. material, $1,588; 12 pkgs. machinery, $796. Malta—1 pkg. material, $12. New Zealand—15 pkgs. material, $712; 98 pkgs. copper wire, $23,818; 6 pkgs. machinery, $600; 28 pkgs. wire, $405. Newcastle—8 pkgs. machinery, $1,000. Naples—21 pkgs. material, $550. Nova Scotia—4 pkgs. material, $125. Peru—10 pkgs. material, $445. Plymouth—13 pkgs. copper wire, $600. Rotterdam—2 pkgs. machinery, $120; 2 pkgs. material, $100. Swansea—25 pkgs. wire, $1,200. Santo Domingo—34 pkgs. material, $371. Southampton—3 pkgs. material, $270. St. Petersburg—1 pkg. material, $35. Trieste—2 pkgs. machinery, $151. Torrenton—1 pkg. machinery, $2,000. Venezuela—2 pkgs. machinery, $21.

ACETYLENE CAR LIGHTING has been introduced with apparent good success on the Lackawanna Railroad by a corporation in which Mr. E. C. Benedict is interested. Tanks are used with acetylene gas under pressure and taken up by acetone, a cheap liquid which has the property of absorbing it eagerly, and which can be charged again and again with little loss. The tanks are lined with porous brick, and the safety conditions, as well as the economical, are said to be most promising. The Commercial Acetylene Company has an office now at 80 Broadway. Among its directors are J. S. Seymour, of the well-known firm of Seymour, Seymour & Harmon, corporation and patent lawyers, at 40 Wall Street ,and who was commissioner of patents under President Cleveland; Frank S. Hastings, Martin J. Quinn, treasurer; Edward Beers, secretary, and Eugene Bournonville. Mr. Seymour is vice-president of the company. The subject is one of much interest to electrical engineers, not forgetting the fact that electricity makes the calcium carbide.

ATLANTIC COAST TROLLEYS.—Clement Newbold, Robert W. Leslie and Francis R. Welsh, a committee representing the holders of $507,000 worth of the $800,000 5 per cent first mortgage bonds of the Atlantic Coast Electric Railway Company, have applied to the Chancery Court for a receiver for that company. An order to show cause why the company should not be declared insolvent and a receiver appointed was granted and made returnable at Chancery Chambers, in Jersey City, on Monday next. The bill sets forth that the company has been running at a loss for some time; that the taxes for 1900 and 1901 are unpaid; that the $20,000 interest on the $800,000 outstanding first mortgage bonds, due Nov. 1, 1901, is unpaid; that the rental of the Seashore Electric Railway has not been paid and that there is much other indebtedness. H. H. Rogers and Daniel O'Day, of the Standard Oil Company, are said to carry the entire floating indebtedness of the company.

A GREAT CHINESE RAILROAD is projected from Canton to Hankow, 750 miles, with $42,500,000 of 5 per cent bonds, and an estimated gross annual business of $50,000,000 for the first year. The New York promoters of the road made announcement last week of the organization of the company which is to build the road under the title of the American China Development Company. William Barclay Parsons, chief engineer of the Rapid Transit road for the city of New York, is the president of the company. The directors are August Belmont, Pierre Mali, member of the importing firm of Henry W. T. Mali & Co., of 83 Worth Street; Frederick W. Whitridge, a lawyer, of 59 Wall Street; Charles A. Whittier, of 111 Fifth Avenue, and Colonel Albert Thys and Mr. Joseph de Volder, of Brussels. A large amount of electrical material will be needed.

MASSACHUSETTS TROLLEY OUTLAY.—The management of the Boston & Northern and of the Old Colony Street Railway companies, which are controlled by the Massachusetts Electric Companies, have some very comprehensive plans in view, which, when completed, are expected to add considerable value to both classes of Massachusetts Electric stocks. The plans are somewhat immature at the present time, but in a general way they involve an expenditure of nearly $10,000,000 in double-tracking, extending and equipping the above two properties, and when changes are completed it is anticipated that the increased earnings resulting therefrom will considerably more than pay the charges or dividends made necessary through the increased capitalization.

THE NATIONAL ELECTRIC SUPPLY COMPANY, Washington, D. C., has recently sold a complete power and electrical equipment for the Government printing office at Manila, Philippine Islands. This equipment includes a complete steam plant, consisting of a Harrisburg Ideal engine connected directly to 150-kw Crocker-Wheeler generator. An Erie City boiler is used to furnish the steam. The fuel used is crude oil, for which purpose a W. N. Best oil burner is to be installed. The shipment, which was sent all at one time, also includes 3000 Edison lamps and 50 fans.

NIAGARA GENERATORS.—For the new power house of the Niagara Falls Power Company, a contract was given some time ago for five 5000-hp generators to the General Electric Company. We are now informed that a further order for five more, completing the equipment of the new building, has been secured by the General Electric Company also. The machines are to be built, it is understood, upon G. E. designs rather than the original specifications of the Power Company, to which the big Westinghouse two-phasers in the earlier plant conform.

EGYPTIAN TROLLEYS.—It is reported that Cleveland capitalists, incorporated as the Cleveland Construction Company, have received concessions for electric car lines from Cairo, Egypt to Mecca. We can't quite figure the route out, but the Red Sea has been known to go dry before now, so there may be something in the rumors. The *Philadelphia Record* says: Cleveland and Chicago capitalists have applied for concessions for electric lines from Cairo, Egypt, to Mount Sinai and thence along the coast of the Red Sea through Syria and Arabia to Mecca with a branch to Damascus.

GENERAL ELECTRIC.—It is stated that the General Electric Company continues to report a record breaking business. Net earnings for December again crossed the $1,000,000 mark, the third month in succession when net earnings have reached that figure. President Coffin sails for Europe again shortly, and is paying close attention to the business of the British Thomson-Houston Company, now controlled by the General Electric Company, which he believes is capable of great expansion under the new regime.

EQUIPMENT WANTED.—Mr. S. M. Veil, secretary and treasurer, Kanawha, Glen Jean & Eastern Railroad Company, Chillicothe, Ohio, reports that the company will be in the market in the spring for complete power plant equipment. The Oklahoma Consolidated Railway Company, Mr. G. W. Willis, El Reno, Okla., $2,000,000 capital stock, will be in the market for the equipment of an electric road and telephone lines from El Reno to Kingfisher, Oklahoma City and Guthrie, 100 miles.

WESTINGHOUSE EQUIPMENT FOR NEW PITTSBURG BUILDING.—The new Frick Building at Pittsburg, Pa., which is being constructed by the George A. Fuller Company, whose New York address is 137 Broadway, is to be installed with four 150-kw Westinghouse generator sets for direct connection to the same number of Westinghouse compound engines, having a capacity of 225 kw each.

POWER PLANT FOR SILK MILL.—It is announced from New Haven, Conn., that a large electric power plant on the Hockanum River for the Cheney silk mills at South Manchester, Conn., will soon be completed. Water is carried by a pipe half a mile to the electric power house, whence the current is supplied to the mills, two miles away. The total cost of the plant is estimated at $300,000.

THE INTERNATIONAL STEAM PUMP COMPANY has bought 40 acres of land in Harrison, N. J., and will build shops to give employment to about 2500 men. The company is the well-known combination of some of the largest steam pump manufacturers, including the Worthington Company. The land bought cost about $55,000. Seven brick buildings, 145 by 600 ft., will be built.

ELECTRIC LIGHT EQUIPMENT.—The Superior Water, Light & Power Company, West Superior, Wis., will make extensive improvements to its plant during the coming summer, and will require new equipment, for which it is proposed to expend $35,000 or more. The plans have not yet been completed, however.

THE LAKE ERIE IRON WORKS, Cleveland, Ohio, have recently added to their electric plant a 160-hp engine, built by the Ball Engine Company, of Erie, Pa., and direct connected to a General Electric Company's generator. This is a duplicate of a unit installed a year ago.

ENLARGING POWER PLANT.—The power plant of the Diamond Rubber Company, of Akron, Ohio, will be enlarged and the machinery will probably be driven by electric power. The company has recently increased its capital stock in order to provide for these improvements.

ROGERS ELECTRICAL WORKS.—Notice has been given of the dissolution of partnership between Ulysses G. Rogers and Louis H. Wenzel, in the above works, at 55 Dey Street, New York City. The business will hereafter be carried on by Mr. Rogers.

PITTSBURG LIGHT AND ICE.—It is said the Philadelphia Company, which recently acquired trolley and lighting interests in Pittsburg, is after the ice business of that city.

General News.

THE TELEPHONE.

ATTALLA, ALA.—The City Council granted a 20-year franchise to the Alabama & Georgia Long Distance Telephone Company to operate a local exchange.

SAN FRANCISCO, CALIF.—The Pacific States Telephone & Telegraph Company recently gave a banquet at Delmonico's, in San Francisco, to the 200 employees, included among them solicitors, linemen and instrument installers of the local telephone system. Heads of departments feasted with the men, and pledged one another a happy New Year. Mr. John Curran, at the head of the contracting department, made a speech of welcome and read a letter from President John I. Sabin and Vice-President Louis Glass. It congratulated the employees on the fact that through their efforts San Francisco had reached the highest percentage of telephone subscribers of any city in the world. The 30,000 mark was reached and passed during 1901, there being that number of telephones now in use, the population of the city being 342,782.

DENVER, COL.—On Jan. 1 the Colorado Telephone Company reduced its toll rate from a five-minute to a three-minute conversation basis.

COLORADO SPRINGS, COL.—The Colorado Telephone Company is planning extensive additions to its service. About 2500 feet of aerial wire will be put up at once, and a new switchboard will soon be installed. A large amount of wire will be placed underground and the system brought up to the standard, as the company expects a large increase of business over that of last year.

ARRAN, FLA.—Mr. F. N. Duval is putting in a telephone between here and Crawfordville.

DANVILLE, ILL.—The Sidell Telephone Company will extend its lines in the spring.

CARMI, ILL.—The Cumberland Telephone Company has transferred its plant to the White County Telephone Company.

MARSHALL, ILL.—The Wabash Valley Telephone Company, capital stock $30,000, has been incorporated by H. H. Knipe, A. L. Keys and G. W. Fair.

ST. ANNE, ILL.—A number of enterprising farmers west of St. Anne held a meeting and decided to run a telephone line west of St. Anne, a distance of at least five miles.

CHICAGO, ILL.—The Mutual Union Telephone Company, of Abingdon, has been incorporated; capital, $2,500. Incorporators: Leonard E. Cutler, William H. Beaver, Nellie A. Cutler.

EAST ALTON, ILL.—The Kinloch Telephone Company encountered opposition at East Alton last week, when an attempt was made to build a line through the village. A franchise was granted, but the telephone company allowed the time limit to pass without beginning work. When a start was made preparing for the erection of a line of poles by a gang of Kinloch workmen, the president of the village board ordered the work stopped. The company was later granted a 20-year franchise.

DUNKIRK, IND.—The Citizens' Telephone Company, capital stock $10,000, has been incorporated to operate in Jay, Delaware, Randolph and Blackford counties.

PERU, IND.—At a meeting of the directors of the new Home Telephone Company arrangements were made to build at once a line to Mexico and Denver; also a long distance line to Wabash.

SOUTH BEND, IND.—The South Bend Home Telephone Company, capital stock $200,000, has been incorporated by J. E. Neff, E. H. Miller, M. B. Staley, D. D. Bates and H. G. Miller. The company will operate an independent telephone system in South Bend.

INDIANAPOLIS, IND.—The Northern Indiana and Southern Michigan Telephone & Telegraph Company has reincorporated and increased its capital stock from $50,000 to $75,000. The Citizens' Telephone Company, of Zionsville, has filed articles of incorporation with the Secretary of State. The capital stock is placed at $10,000. The company has purchased the holdings of the old company and is arranging to connect with adjacent towns and otherwise extend its lines.

ANDERSON, IND.—The Madison and Delaware County Telephone Company, with a capital stock of $500,000, has been organized at Ft. Wayne, with the following stockholders: J. J. Netterville, G. C. Quick and W. H. H. Quick of this city; A. L. and J. C. Johnson and W. H. Hitchcock, of Muncie; Wayne Leeson, of Elwood; S. M. Foster, G. W. Beers, Max Fisher and W. P. Breen, of Ft. Wayne. Mr. Foster was made president. The company was organized for the purpose of installing a telephone service throughout this and Delaware counties, connecting Muncie, Elwood, Alexandria, Frankton, Summitville, Eaton, Pendleton and Anderson. Franchises have been obtained in all of the places. The prime object of the company, however, is to furnish a service for the farmers. The Gas Belt Construction Company was also organized with a capital stock of $100,000. W. H. Hitchcock, of Muncie, was made president of this company. The stockholders of this company are the same as in the other. The object is to put in an independent telephone service throughout the Indiana gas belt. The work on both services will begin at once and pushed to completion in the early summer.

DE WITT, IA.—The De Witt Telephone Company has been incorporated.

WILTON, IA.—The Wilton Telephone Company has been granted a franchise here.

SPRINGVILLE, IA.—The Springville Telephone Company, capital stock $5,000, has been incorporated by J. D. Graham, L. B. Christman, E. H. Sidwell, T. W. Pollock, W. J. Courtney and C. F. Butler.

SIOUX CITY, IA.—Another independent telephone company wants to get a franchise in Sioux City. C. F. Moody, representing an independent company at Fergus Falls, Minn., states that his company would like to secure a franchise and put in an exchange here.

HANCOCK, IA.—Twenty-four farmers of Hancock Township have formed a telephone company. Articles of incorporation of the Hancock Telephone Company were filed with a capital stock of $10,000. T. J. Armstrong is president; Chas. Warner, vice-president; Adolph Schmidt, secretary, and Fred. J. Boie, treasurer.

KIOWA, KAN.—The Kiowa Telephone Company, capital stock $5,000, has been incorporated.

PITTSBURG, KAN.—The Pittsburg Telephone Company, capital stock $50,000, has been incorporated.

ELDORADO, KAN.—The Butler County Telephone & Electrical Company, capital stock $2,000, has been incorporated.

DAWSON SPRINGS, KY.—The Cumberland Telephone Company is putting in an exchange at Dawson Springs. This exchange will be operated in connection with the Madisonville and Earlington exchanges.

PARIS, ME.—The Paris & Greenwood Telegraph & Telephone Company, of Paris, capital $5,000, has been incorporated by E. H. Herrick, Greenwood, Me.; F. D. Small, West Paris, Me.

BOSTON, MASS.—The Erie Telephone system made a net gain of 1880 subscribers in December. Net gain for the year, 20,085. Total connected Dec. 31, 162,455; waiting connection, 1968.

MILFORD, MICH., will have a telephone exchange, provided the Council will grant a franchise which has been asked for.

PLAINVIEW, MINN.—The Greenwood Prairie Telephone Company, of Plainview, Minn., capital $25,000, has been incorporated.

ST. LOUIS, MO.—The Bell Telephone Company, of Missouri, will pay its quarterly dividend of 2 per cent. on $2,000,000 in January.

ST. LOUIS, MO.—The conduit extension bill now before the City Council Committee is opposed by the Kinloch Telephone Company, and the Western Union Telegraph Company on account of the expense, the necessity for keeping the streets repaired, the right of the city to purchase the subway, and the new conditions arising, and may change materially telephone and telegraph equipment.

NEWPORT, NEB.—The Interstate Telephone Company is extending its lines west to Valentine, Neb.

VALENTINE, NEB.—A company has been organized to put in a telephone system at this place. It is the intention to ultimately extend the line to various parts of the county.

LIBERTY, NEB.—The Liberty Independent Telephone Company, of Liberty, capital stock $5,000, has been incorporated. George Sutter is president, and C. F. Maxwell, secretary.

CONCORD, N. C.—A metallic telephone connection has been completed between Concord and Albemarle, N. C.

MARSHALL, N. C.—The Madison Telephone Company contemplates several extensions, possibly to Hot Springs and Alexander. An exchange for Marshall is being discussed also.

HICKORY, N. C.—The Sunban Telephone Company has been incorporated with $20,000 capital to operate telephone lines in Catawba County. W. R. Abernathy, of Newton; J. L. Latta and J. A. Martin, of Hickory, are the incorporators.

CANNON BALL, N. D.—A telephone line has been constructed between this village and the sub-agency. The Indians were afraid of the telephone at first, but now they are getting to use it too much, and call up the sub-agent on every occasion.

ELMER, N. J.—The Pittsgrove Township Committee has granted a franchise to the Interstate Telephone Company to erect its lines through the township.

NEW YORK, N. Y.—Senator Wagner, of Kings, has introduced in the State Senate a novel telephone bill, designed to prevent extra telephone charges for messages between the boroughs in the city of New York. The bill provides that it shall be unlawful for any person, partnership, or corporation operating a public telephone system for the general transmission of messages by telephone in the city of New York to charge an extra sum in addition to its regular rates for any message sent from one borough to another within the limits of the city.

SHREVE, OHIO.—The Ripley Telephone Company has been incorporated with a capital of $5,000.

ST. CLAIRSVILLE, OHIO.—The Belmont Telephone Company has opened a new exchange at St. Clairsville.

UPPER SANDUSKY, OHIO.—The Upper Sandusky Telephone Company has increased its capital stock from $12,000 to $30,000.

NORWALK, OHIO.—The Huron County Telephone Company is preparing to build a number of farmers' lines in this vicinity.

ALLIANCE, OHIO.—The Central Union Telephone Company is preparing to double the capacity of its long distance toll board in this city.

GALLIPOLIS, OHIO.—The Gallipolis Telephone Company has completed an exchange at Chickamauga. Gallia County is fast being covered with farmers' lines.

GERMANTOWN, OHIO.—The Germantown Telephone Company has had remarkable success during the past year, having more than doubled its list of subscribers.

COLUMBUS, OHIO.—H. E. Williard, superintendent of the central division of the American Telephone & Telegraph Company, will remove his headquarters to Columbus.

NORWALK, OHIO.—The Lake Shore Electric Railway and the Central Union Telephone Company are having a lawsuit over a line of poles through Norwalk which each company claims as its property.

TOLEDO, OHIO.—Frank E. Graves, general manager of, and one of the promoters of the Toledo Home Telephone Company, has resigned because of ill health. He is now recuperating in California.

CANTON, OHIO.—Acting under instructions from headquarters, work has been resumed on the Canton exchange of the Stark County Telephone Company, one of the Federal companies. Regular service will be inaugurated within a few days.

CINCINNATI, OHIO.—The Norwood Messenger, Police & Fire Company is applying for a franchise in that village. The members of the new company are Patrick Shortall, Edward P. Mouliner, Samuel J. Murray, William Windhorst and John Rolsen.

MANSFIELD, OHIO.—Work on the exchange of the Mansfield Telephone Company, which is practically completed, will not be delayed through the troubles of the Everett-Moore syndicate. Telephones are all in place and underground cables are being put in.

WAUSEON, OHIO.—E. L. Barber, of this place, has obtained a franchise for an independent telephone system in Kansas City. The company has put up $20,000 cash to insure the building of the plant. Long distance lines will be built throughout Kansas.

AKRON, OHIO.—D. Emil Dorn, of Chicago, has communicated with the City Council asking if a franchise could be secured for a new independent telephone system. The city already has a very large independent system besides that of the Bell company.

WARREN, OHIO.—The Warren & Niles Telephone Company has elected officers as follows: Washington Hyde, president; Jules Vautrout, Jr., vice-president; J. J. McLean, secretary-treasurer, and E. G. Miller, general manager. The above, with C. C. Clawson, M. S. Clapp and C. W. De Voe, are directors.

ZANESVILLE, OHIO.—The School Board has awarded a contract to the Central Union Telephone Company for telephone service in eighteen school buildings at a rate of $12 per year for selective party line. The Zanesville Telephone & Telegraph Company offered full metallic service for $18 per year.

ZANESVILLE, OHIO.—J. B. Rhodes, general manager of the Zanesville Telephone & Telegraph Company, one of the Federal properties, has been notified that the financial difficulties of the Everett-Moore syndicate need not interfere with the construction work on the Zanesville exchange, which is practically completed.

OBERLIN, OHIO.—The Oberlin Telephone Company has elected directors as follows: E. H. Holter, A. S. Root, C. K. Whitney, A. G. Comins, M. M. Squire, J. R. Severance and E. P. Johnson. The company is in a most prosperous condition. A 4 per cent. dividend was declared and a surplus will go toward improving the plant.

CHAGRIN FALLS, OHIO.—The old fight between the village of Chagrin Falls and the Cleveland Telephone Company will be fought all over again. The village granted the required franchise, but specified that wires must be placed underground. The company claims it is impossible to comply with the demand, and has again appealed to the Probate Court.

McCOMB, OHIO.—The McComb Telephone Company, which is owned and managed by Miss Angie Fruchie, will build a number of rural lines in Hancock County. Miss Fruchie has managed the system for a number of years and has made a thorough success of the venture. The Bell Company has been repeatedly defeated in its attempt to secure a franchise in this town.

MANSFIELD, OHIO.—The Mansfield Telephone Company has secured an injunction restraining John and Levi Watson from cutting the line between Bellville and Darlington. The line was formerly owned by the Watsons, and the Mansfield Company now claims it owns a controlling interest in it. It is claimed the Watsons are preparing to cut the line and connect it with the lines of the Central Union Telephone Company.

CINCINNATI, OHIO.—Contract Agent Westlake, of the City & Suburban Telegraph Association, denies the report that the company is soliciting five-year contracts with the stipulation that any competition will be met. "We are using identically the same five-year contract form that we put in effect in 1898, and do not contemplate any change," he says. "The introduction of the nickel-in-the slot service is the only important departure from our regular contract form. We have now a thousand orders on hand for installations and are troubled only because of lack of equipment."

CLEVELAND, OHIO.—In connection with the financial embarrassment of the Everett-Moore Syndicate it is reported that if a fair offer is made for the property of the Detroit People's Telephone Company the committee in charge of the Syndicate's affairs will be willing to sell the property. About $500,000 has already been spent in Detroit, which with the franchise would make the property worth a considerable figure. If cash could be secured it would go a long ways toward relieving the situation of the Federal Telephone Company. On the other hand, no less a person than Judge J. M. Thomas, president of the Independent Telephone Association, who is here assisting the committee in clearing up the telephone situation, says it is very improbable that the bankers or committee would consider a proposition to sell one of the properties singly. He states that as a matter of fact, the committee is daily becoming more favorably impressed with the value of the telephone properties, and he feels quite confident that matters will be speedily arranged whereby the properties will revert to the Syndicate, and the management of affairs be conducted as heretofore.

TOLEDO, OHIO.—The Central Union Telephone Company has closed the option held for the past four months on the property of the Harrison Telephone Company of Toledo. The Harrison company was one of the first independent companies in Ohio. It was organized nine years ago by Henry Cook. It proved a financial failure and four years ago was sold at receivers' sale for $20,000 to George Hill, who later sold it to L. C. Cole, John R. Hankey and others of Bowling Green. The new owners spent $50,000 in improvements, and at present the plant consists of 600 telephones, 8 miles of cable, 60 miles aerial wire and 20 miles of poles. Of late years the company has not been recognized as a strictly independent company, and it has had no connection with the long distance lines of the United States Telephone Company, although it has connected with several independent exchanges in the vicinity of Toledo. The terms of the sale were not announced, but the Bell company will pay a $50,000 mortage against the company. The purchase of the plant is a part of the plan of expansion of the Bell company in Toledo in order to better compete with the new Toledo Home Telephone Company, which will shortly commence operations with a large subscription list.

OTTAWA, ONT.—At the approaching session of the Dominion Parliament, the Bell Telephone Company will ask for an amendment to its charter and for power to increase its capital stock. This means a renewal of the bitter contest that took place before the parliamentary committee last session between this corporation and the municipal authorities of Canada, chiefly of the province of Ontario, when the same powers were sought by the Bell Company, in regard to the question of telephone rates.

HULMEVILLE, PA.—The Standard Telephone Company has been granted a franchise.

CARNEGIE, PA.—A telephone line from Lawrence to Thomas Station is about to be built.

PHILADELPHIA, PA.—The Keystone Telephone Company has made its first official "call" from the newly equipped "Central" in what was formerly the Commercial Exchange, Second and Sansom Streets.

MADISON, S. D.—The telephone exchange in this city has been sold to the Southwestern Minnesota Telephone Company, which has taken possession. The consideration was $6,000.

CANTON, S. D.—The Lincoln County Telephone Company has let the contract for the construction of thirteen miles of telephone line extending from Beresford in a northwest direction, for the convenience of the farmers comprising the company.

STURGIS, S. D.—The Harrison Telephone Company has secured a charter in Montana and intends extending its system in that direction. It is probable that work will be commenced in the spring which will connect the Black Hills with the telephone system of the Northern Pacific Railroad. The Harrison Company already has a charter in Wyoming and its lines in that State will also be placed in connection with the Black Hills-Montana system.

MILWAUKEE, WIS.—The Calumet Telephone Company filed an amendment to its articles increasing its capital stock from $500 to $1,500.

KENOSHA, WIS.—The Wisconsin Telephone Company is trying to lease the Farmers' Telephone lines, which has strung wires to the city limits.

WAXAHACHIE, TEX.—Work has been commenced on a new telephone system for Waxahachie. The line will be extended from here to Ennis.

MADISON, WIS.—The Wisconsin Central Telephone Company, of Stevens Point, with a capital stock of $200,000, filed articles of incorporation. The incorporators are A. L. Hutchinson, H. G. Slater and E. H. Jones.

ELECTRIC LIGHT AND POWER.

MONTGOMERY, ALA.—The recent flood in the Tallapoosa River damaged the dam of the Tallahassee Electric Company to the extent of $40,000.

SAN FRANCISCO, CALIF.—The Standard Electric Company, which represents an investment of $5,000,000, has nearly completed its long distance electric transmission line from Amador County to San Francisco.

REDLANDS, CALIF.—The city trustees have under consideration two propositions made by Judge L. Campbell, of San Bernardino, and Prof. C. G. Baldwin, of Pomona, to supply the city with electricity generated by water power in the San Bernardino mountains.

SAN FRANCISCO, CALIF.—The San Francisco Mint is to be electrically equipped during the present year. As far as possible, electricity will be used to supply motive power for machinery, etc., as well as for metallurgical and testing purposes. The changes, which will be made gradually, will cost the Government $150,000. It is the intention, ultimately, to install an independent generating plant to supply current for electrical machinery.

DENVER, COL.—The Denver Gas & Electric Company has notified the Mayor that it will discontinue its service on Jan. 10 and remove its arc lamps from the streets. This will afford the Lacombe Company a clear field. The Denver Gas & Electric Company will continue to press its claim for $65,000 on account of light furnished during the past year, when, it alleges, it had a contract with the city.

GAINESVILLE, FLA.—New machinery for the electric light plant has been received and is being placed in position. A thorough overhauling will also be made throughout the town.

MURPHYSBORO, ILL.—The Murphysboro Water Works, Electric & Gas Light Company's capital stock has been increased from $80,000 to $160,000.

GREENVILLE, ILL.—E. G. Bruckman, of St. Louis, Jan. 2 sold the Greenville electric light plant to a syndicate of Greenville business men for $25,000 spot cash. The Greenville men who compose the syndicate are: Edmond Demoulin, Ulysses de Moulin, J. Seaman, F. P. Joy, E. M. Gullick, Charles Von Weise, C. L. Hoiles, and Guy B. Hoiles. The plant was built by Mr. Bruckman, who is manager of the Imperial Electric Light Company, of St. Louis, and has a twenty-four-year franchise.

MARION, IND.—The Marion Light & Heating Company has been incorporated, with a capital of $300,000. The board of directors is headed by B. F. Burk. The company proposes to establish a heating, lighting and power plant in this city.

NEW ORLEANS, LA.—Sealed proposals will be received until March 24 next for the construction and operation for ten years of an electric street light system, to revert to the city of New Orleans at the expiration of that period. The city engineer will furnish printed specifications and all other information.

YAZOO CITY, MISS.—The contract for drawing plans for the new electric light, water and sewerage systems has been given to Kirkpatrick & Johnson. This is done with a view to obtaining an idea of the cost of the proposed work, which is roughly estimated at $150,000.

ST. LOUIS, MO.—The Laclede Power Company, of St. Louis, has filed a statement of increase of capital from $400,000 to $800,000.

ST. LOUIS, MO.—Bids for supplying the power to drive the World's Fair machinery and supply the electric lights, have been made by a number of electric manufacturing companies. Among those bidding for the power contract is the Citizens' Electric Lighting & Power Company, of St. Louis. The company's new plant will be ready Nov. 1, 1902. The entire plant is guaranteed to be in operation by April 1, 1903. There will be three 4000-hp alternating engine-type dynamos; two 2000-hp vertical cross-compound condensing Corliss engines, running at 75 r. p. m., and two 2000-hp engines of the same description.

MARSHALL, N. C.—The North Carolina Electrical Power Company has executed a deed of trust to the Mercantile Trust & Deposit Company of Baltimore, to secure $80,000 six per cent. bonds, with the privilege of liquidation at the option of the power company.

GOLDSBORO, N. C.—The Board of Aldermen has reversed a former decision which in turn was a reversal of a previous decision to purchase the local electric plant, and now the city will purchase for $25,000 the plant of the Goldsboro Traction & Illuminating Company. The Aldermen decided on this some time ago, but it was developed that the action was contrary to the State Statutes. Now those Aldermen holding interests in the local company have disposed of these and again decided to purchase the plant for the city.

NEW YORK, N. Y.—Assemblyman Adler has introduced a bill for a municipal lighting plant for New York City.

HORSEHEADS, N. Y.—The village Board of Trustees has invited sealed bids for furnishing light to the village on or before Feb. 4.

SOUTHAMPTON, N. Y.—The Suffolk Light, Heat & Power Company, of Southampton, has let contracts for the installation of its plant.

AMSTERDAM, N. Y.—The Edison Electric Light & Power Company, of Amsterdam, has filed with the Secretary of State a certificate of increase of its capital stock from $18,000 to $100,000. The principal stockholder in the company is the Amsterdam Street Railway Company, of which J. Ledlie Hees, of Fonda, is president.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—After some weeks of negotiations, the Colgate and Martin syndicate has obtained control of the North Pacific Coast Railroad, which extends 94 miles northward from Sausalito, Calif. A new corporation will be organized for the purpose of improving and extending the narrow gauge railroad line. The purchasers are R. R. Colgate, R. M. Hotaling, W. M. Pierson, C. A. Grow, E. J. de Sabla, Jr., and John Martin. The capital stock of the company will be $6,000,000. The early improvements will consist of changing the roadbed to standard gauge from Sausalito to San Auselmo, double track throughout, from Mill Valley Junction to Mill Valley and from San Auselmo to San Rafael. These portions of the lines will be changed over to an electric system and electric power for its operation will be taken from the Colgate power station via the Bay Counties transmission line. The ferry connections with San Francisco will be improved.

ANDERSON, IND.—The Anderson Merchants' Association is promoting an electric railway to connect Anderson with Daleville and Middletown.

SOUTH BEND, IND.—Right of way has been secured for an electric road from this city to Michigan City and a line will be constructed into Chicago at a cost of $2,000,000.

INDIANAPOLIS, IND.—The Indianapolis merchants have asked President McCulloch, of the Union Traction Company, to furnish a sufficient number of freight cars to carry their merchandise out of the city to customers in the smaller cities and towns. They say their customers complain when shipment is made over the steam lines.

INDIANAPOLIS, IND.—The Indianapolis & Martinsville Rapid Transit Company has executed a mortgage for $750,000 for the purpose of floating bonds to that amount. The Union and the Security Trust companies of this city are named as trustees. The bonds are thirty-year 5 per cent. bonds. The company expects to be running cars to Mooresville in a short time and have the entire line in operation by May 1.

INDIANAPOLIS, IND.—The Indianapolis & Western Traction Company has filed articles of incorporation to operate a line of electric cars between Indianapolis and Plainfield, and ultimately to Danville. Charles Finley Smith, president of the Indianapolis & Martinsville Rapid Transit Company, is also named as president of the new company. The company has quietly purchased a right of way, paying as high as $150 an acre in some instances.

BLUFFTON, IND.—A combination electric and steam railroad is projected to run from this city to Pennville, Muncie, Selma, Albany and Dunkirk, and possibly to Ft. Wayne. It is announced that this line is to be built for the transportation of passengers by electric power and the transportation of freight by steam. The company title is the Ohio & Indiana Railway Company. W. H. Schott, of Chicago, is president, and says rights of way have been secured, subsidies voted in Jay County, and that $1,500,000 of bonds will be issued to build the road. South Bend, Dunkirk and Indianapolis men are interested with Mr. Schott in the enterprise.

DETROIT, MICH.—The Detroit & Toledo Shore Line Company has filed a mortgage for $3,000,000, given to the Metropolitan Trust Company of New York to secure thirty-year 4½ per cent. gold bonds.

MINNEAPOLIS, MINN.—The Minnesota & Iowa Electric Railway Company has been incorporated to build a line from Decorah, Iowa, to connect with the Minneapolis and St. Paul system. The capital stock is placed at $500,000. H. R. Wells is president, R. E. Thompson, vice-president; H. Kupson, treasurer, and S. A. Langum, secretary, all of Preston. The principal place of business is Preston, Minn.

FINDLAY, OHIO.—Except for two bridges the Toledo, Bowling Green & Southern Railway is complete between Toledo and Findlay.

DOYLESTOWN, OHIO.—The Doylestown Council has granted a franchise through town to the Canton, Lodi & Medina Railway Company.

CONNEAUT, OHIO.—The Millcreek Township Commissioners at Erie, Pa., have granted a franchise to the Conneaut & Erie Traction Company.

PAINESVILLE, OHIO.—Messrs. Goodrich, Tuttle and Stanley, who some time ago proposed building a road through Lake County, have brought suit against the County Commissioners to recover $38,500 damages. Plaintiffs allege that they secured a franchise for the road and deposited $2,000 to commence work by May 15, 1901. They claim the franchise was extended, but in August the franchise was declared void and the money forfeited. The plaintiffs allege work was started in accordance with the terms of the franchise and that the forfeiture spoiled their proposition.

THE AUTOMOBILE.

CHICAGO AUTOMOBILE CLUB.—A telegram from Chicago of Jan. 10 says: In its efforts to perfect a national organization, the Chicago Automobile Club is to ignore the Automobile Club of America, the New York organization. A national meeting will be held here in the first week of March, when the automobile show will be in progress. Invitations have been extended to the Long Island and Boston clubs, but the New York association will not be formally invited to participate. This attitude has been taken by the Chicago men because, they say, the Eastern club is attempting to run the proposed organization without giving the other clubs a fair deal in the preliminary arrangements. The New York club, it is said, has insisted that its racing rules must be accepted and that representation be based upon the population of the respective cities. The Chicago men want equal representation, according to membership, and racing rules that may be agreed upon by the National body, when organized.

NEW INDUSTRIAL COMPANIES.

THE ACME ELECTRIC APPLIANCE COMPANY, with a capital stock of $5,000, all paid, has filed articles of incorporation at St. Louis, Mo. Wm. A. Cowas, H. E. Cowas and J. E. Reid are the incorporators.

THE KNOWLES & TILLMAN TELEPHONE TRANSMITTER MANUFACTURING COMPANY, capital stock $10,000, has been incorporated at Buffalo, N. Y., by W. K. Knowles, B. J. Tillman and A. V. Tillman, of Buffalo.

THE UNITED STATES LIGHT & HEATING COMPANY, capital $3,000,000, has been incorporated at Trenton, N. J. The company is to furnish electricity, light and heat, especially for railways and railway cars. The incorporators are William B. Irwin, Wallace Young and John J. Gilbert, all of Jersey City.

LEGAL.

CUYAHOGA TELEPHONE COMPANY.—The Western Electric Company has brought suit in the United States Circuit Court at Cleveland, Ohio, against the Cuyahoga Telephone Company, Henry Everett and John Sherwin, officers of the company. The suit is over the alleged use by the Cuyahoga company of the supervisory signals on switchboards under patents granted Aug. 20, 1901, to Charles E. Scribner. An injunction is asked to prevent the Cuyahoga company from further use of the appliances and damages are asked for.

OBITUARY.

MRS. T. T. ECKERT.—We regret to note the death, after a long illness, of the wife of General T. T. Eckert, president of the Western Union Telegraph Company.

MR. M. HARTLEY.—The death occurred suddenly on Jan. 8, at a board meeting of the American Surety Company, of Mr. Marcellus Hartley, one of the leading financiers of New York City, who had a great deal to do with the early history and development of electric lighting in New York, and electric manufacturing in general.

MR. O. W. MEYROWITZ.—One of the victims of the tunnel collision on the New York Central Railroad last week was Mr. Oscar W. Meyrowitz, forty-seven years old, secretary of the Meyrowitz Manufacturing Company, optical goods, at 104 East Twenty-third Street, and manager of eleven stores which bore his name in this and other cities. He was a brother of Paul Meyrowitz and E. B. Meyrowitz, prominent opticians, and lived at New Rochelle. He was secretary of the New Rochelle Yacht Club, a member of the Reform Club, the Royal Arcanum, and a veteran of the Twenty-second Regiment, N. G. N. Y. Mr. Meyrowitz was born in Stettin, Germany, and came to this country when sixteen years old, to join E. B. Meyrowitz, now the president of the manufacturing company, with whom he also became an expert optician. The concern is very well known in electrical circles.

PERSONAL.

PROF. F. B. CROCKER, of Columbia University, has returned from his brief trip to Cuba, much improved by the sea voyage.

Mr. O. M. SOUTHWORTH, chief electrician of the Commercial Electric Company of Indianapolis, was a visitor in Chicago recently.

MR. W. FRANK PIERCE has been elected president of the Standard Electric Company, of California, to succeed Prince Poniatowski.

MR. LAMAR LYNDON, the electrical expert, has just returned from the West Indies, where he went to report on an electric railway.

PROF. W. E. GOLDSBOROUGH, head of the electrical engineering department of Purdue University, Lafayette, Ind., has been recommended as chief of electrical exhibits at the St. Louis World's Fair, by the Committee on Electricity and Electrical Appliances.

PRINCE ANDRE PONIATOWSKI recently resigned the presidency of the Standard Electric Company, of California, and left San Francisco for a visit to New York.

MR. HENRY C. PAYNE, whose coming East has been delayed by the death of a friend in Milwaukee, will qualify as Postmaster General and assume his new duties this week.

MR. FRANCIS HIRD, of Siemens Bros. & Company, Limited, who was here last spring, has not forgotten a New Year reminder to those who had the pleasure of making his acquaintance on this side.

PROF. S. P. THOMPSON has remembered his many friends in this country with an original Christmas card in his own name and that of his wife, embodying a very apt and charming quotation from Maarten Maartens.

MR. JOHN I. SABIN, president of the Pacific States Telephone & Telegraph Company, and also manager of the Bell companies operating in and around Chicago, recently left for the East after visiting his old home in San Francisco.

MR. W. J. CLARK has been sending a neat New Year personal card to his host of old time friends "at home." He is now settled in London on behalf of the General Electric Company, and extremely busy, but not over fond of the weather.

MR. JOHN L. LIVERS, superintendent and electrician of the Harper's Ferry, W. Va., Electric Light & Power Company, has accepted a similar position with the Chesapeake & Potomac Telephone Company, with headquarters at Cumberland, Md.

MR. M. G. STRATTON, recently connected with the Richmond Passenger & Power Company, of Richmond, Va., has been appointed superintendent of the Meter Department of the Lachine Rapids Hydraulic & Land Company, of Montreal, Canada.

MR. GAYLORD THOMPSON, general manager of the New Castle, Pa., Electric Company, the New Castle Traction Company, and the Lawrence Gas Company, has succeeded Mr. E. E. Hamilton as secretary and treasurer of those properties, the latter having resigned.

MR. J. G. WHITE, head of the firm bearing his name, has had a much more serious illness than is generally known, but is now safely on the road to convalescence at his apartments in New York, and has even been able to see callers. His recovery is a matter of hearty congratulation on the part of a host of friends.

MR. GEORGE A. DAMON, managing engineer of the Arnold Electric Power Station Company of Chicago, lectured before the engineering students of the University of Illinois, Jan. 10, on "How a Power Station is Designed," a subject which Mr. Damon is abundantly able to handle through his extensive experience along that line.

MR. JAMES HAMILTON, U. S. A., retired, has become associated with Mr. Edw. S. Beach, of Boston, Mass., and the two will jointly conduct a law business, making a specialty of patents, trade marks and copyright cases in all courts of the United States, and patent and trade-mark soliciting in all countries. The address of the firm is 53 State Street, Boston.

MR. HAROLD ALMERT, formerly electrical engineer of the Lincoln Park Board of Chicago, and who recently completed the electric lighting of Diversey Boulevard, which is now the best lighted thoroughfare in Chicago, left that position the first of the current year to become associated with the Buckeye and Jandus Electric Companies' western office, 1537 Monadnock Block, Chicago.

MR. W. R. MASON.—The many friends of W. R. Mason will be pleased to hear that he has returned to Chicago and will be connected with the Sprague Electric Company in the Chicago office. Mr. Mason has successfully represented the Walker, Siemens & Halske and Stanley companies in St. Louis for the last four years, but has been anxious to return to Chicago. His long experience in the electrical business, beginning at first with the original Sprague Electric Motor Company, and later in the supply business, has given him a close personal acquaintance with the trade extending over the entire country.

Trade Notes.

THE STANDARD ARM AND PIN COMPANY, Laurel, Miss., expects to have its new manufacturing plant in operation by Jan. 15. It will manufacture crossarms, brackets and pins for telegraph and telephone poles. The company also operates plants at Gadsden, Ala., and in Georgia.

THE ALPHA ELECTRICAL CONSTRUCTION COMPANY, 29 and 31 Gold Street, New York, was recently formed to do a general construction, repair and manufacturing business. It is thoroughly equipped for telephone and telegraph repair work on a large scale. Its clients include some of the largest concerns in this line.

HYDRAULIC VALVES.—A complete line of hydraulic valves and fittings is shown in catalogue No. 63, of the Watson-Stillman Company, New York. The illustrations are very clear, many of the devices being shown diagramatically as well as in perspective. The catalogue is made up from an assortment of sheets selected from the illustrated sheets describing hydraulic tools manufactured by this company.

RAILROAD DINING.—It is stated that the New York Central Railroad, which operates more dining cars as well as more sleeping and parlor cars than any other road in the world, has twenty-eight dining cars and eight restaurants and is now feeding more than 8,000 persons a day. Each dining car costs $15,000. Including the food supply constantly on hand, the Central has therefore about half a million dollars invested in the enterprise of feeding passengers while they are moving.

ELECTRICAL SUPPLIES CATALOGUE.—Messrs. Lowe & Leveridge, 183 Greenwich Street, New York, have just issued a catalogue of electrical supplies. The variety of goods carried by this firm is a very extensive one, as indicated by the catalogue, which has 388 pages, exclusive of the index. The first few pages at the front contain views of plants in which Lowe & Leveridge apparatus is installed, also several views of switchboards installed by the firm in various places. The catalogue measures 5x6¾, and is consequently of very convenient size.

THE NEW YORK SAFETY STEAM POWER COMPANY, 113 Liberty street, New York, will have ready for distribution within ten days its new catalogue of automatic engines, arranged for both belted and direct-connected service, low and high pressure duty, heavy service. These engines are equipped with double ported piston valves. One of the unique features of the engine is the Nichols shaft governor, which has given excellent results in heavy duty electric light work. The duplicate part system of the company whereby any repair part can be promptly identified and furnished upon telegraphic order is an important branch of the business.

THE 1902 CALENDAR issued by the American Electrical Works of Providence, R. I., of which Mr. Eugene F. Phillips is general manager, is well up to the standard of good taste which this company has established by precdeent in its calendars of previous years. The illustration is a fine steel engraving of Alessandro Volta, and on the reverse side of the calendar are some historical facts speaking of Volta's experiments and discoveries. A phrase which occurs in this story of Volta which is worth repeating is one calling attention to the work of Volta as somewhat coincident with that of Franklin and Faraday, the "three constituting a kind of electrical F. F. V."

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, is sending out to the trade a daily reminder calendar for use on the desk, mounted on an iron frame, and gotten up in a very substantial manner. The company states that on account of the flattering success which it has met with in the sale of its Emerson alternating current ceiling and desk fans, and its Peerless direct current fans, it is endeavoring to contract for fans earlier this year than before, as it expects an unprecedented demand. Last year the entire output of its factory was sold before June 1. The company reports that it has already closed a very large number of contracts. It has gotten up two very attractive catalogues, illustrating current fans. These will be mailed on application.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED JAN. 7, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

690,059. REGISTERING METER; E. S. Isham, Jr., New York, N. Y. App. filed Nov. 6, 1901. Two supporting thermostats adapted to expand uniformly in opposite directions by variations in atmospheric temperature, means for applying a measurable quantity of heat to one of the thermostats and an index acted upon by both thermostats. (Issued Dec. 31, 1901.)

690,386. ELECTRIC RAILWAY; F. M. Ashley, Brooklyn, N. Y. App. filed Feb. 25, 1898. The automatic switch for throwing the current from the feeder to a section of the sectional conductor, consists of a solenoid magnet having one end of its core immersed in mercury, from which it is never withdrawn, and which forms one terminal; the other end of the core being lifted when the solenoid is energized to make contact with another circuit terminal.

690,387. ELECTRIC RAILWAY; F. M. Ashley, Brooklyn, N. Y. App. filed Feb. 26, 1898. A bare conductor is housed in a sealed conduit, one-half of which is of rigid metal and the other half of flexible material, such as leather or sheet rubber. The flexible side supports, exteriorly, a sectional rod connected through the flexible wall with contact pieces which are carried against the bare conductor when the collecting shoe moves against the rod.

690,406. ELECTRIC RAILWAY; G. Davis, West Kensington, Eng. App. filed Nov. 19, 1900. A trolley running on double rails and consisting of a main and a supplemental contact and an arm connecting the contacts and so shaped as to pass wholly without or wholly within, the arm of another similar trolley running on the same rails in the opposite direction.

690,420. REGULATOR FOR DYNAMO ELECTRIC MACHINES; Chas. M. Green, Lynn, Mass. App. filed May 21, 1898. A regulator for arc light machines. There is a rheostat in shunt with the field magnet circuit, a rotary pump driven from the shafting of the machine, mechanism for actuating a rheostat handle and shifting the brushes proportionately; the mechanism being driven by the pump and there being a controlling magnet in series circuit.

690,427. COVERED STRIP OF SOFT METAL AND THE MANUFACTURE THEREOF; I. W. Heysinger, Philadelphia, Pa. App. filed Aug. 29, 1901. A flat, soft metal strip having a covering of textile fabric cemented thereto and a stitched seam sewed through the strip, cement and covering along the flat side.

690,448. STARTING RHEOSTAT FOR ELECTRIC MOTORS; F. Mackintosh, Schenectady, N. Y. App. filed July 15, 1901. One of the sections of the rheostat is sub-divided and independently variable; a shunt is provided around this variable section to kill the spark at the motor contacts.

690,450. ELECTRIC METER; G. H. Meeker, Media, Pa. App. filed April 27, 1900. A part which is moved to an extent proportional to the passing of current, is so related to a vibratory bar that the extent of the vibrations of the bar are limited by the position of the movable part, and means are provided for giving to the bar successive movements, the time intervals between which are inversely proportional to the electrical pressure of the service line wires. The result is the product of amperes, volts and time units.

690,453. SERVICE METER FOR TELEPHONE LINES; F. R. McBerty, Evanston, Ill. App. filed April 9, 1900. (See page 127.)

690,469. MAGNETO ELECTRIC MACHINE; F. R. Simms, Bermondsey, England. App. filed Sep. 20, 1901. The construction of the bearings for a rotating envelope surrounding a fixed armature.

690,479. ELECTRIC SWITCH; E. R. Storm, New York, N. Y. App. filed Oct. 16, 1899. The front plate of a switch box adapted to be set into a plastered wall is adjustable independent of the box, so that it can be set plumb with the face of the wall, notwithstanding the fact that the box itself may be out of plumb.

690,487. LAMP SOCKET; C. J. Tournier, Schenectady, N. Y. App. filed May 17, 1899. A lamp socket having a two-way contact device controlled by the key to permit the lamp to be operated from two points, one at the lamp and one distant therefrom, by the operation of a circuit controller at either point.

690,499. ELECTRIC RAILWAY SYSTEM; H. P. Wellman, Ashland, Ky. App. filed Oct. 9, 1896. A third rail sectional conductor is energized through electro-magnetic switches by means of extra contacts in the road-bed and brushes on the car co-acting to throw the current from the storage battery through the switches.

690,516. COMMUTATOR BRUSH; C. G. Curtis, New York, N. Y. App. filed May 12, 1900. A short carbon block held loosely in a holder so as to be unrestrained in following the irregularities of the commutator, and a spring pressing the block against the commutator.

690,577. SELECTOR; K. Himrod, Chicago, Ill., and J. R. Tucker and C. G. Hinckley, Aurora, Ill. App. filed March 10, 1899. A selector shaft normally maintained under spring tension, a series of locking devices for the shaft adapted when operated to allow movement thereof to different predetermined extents, a magnet for each locking device, a series of selector plates and a contact device carried by the shaft for making contact with any one of the selector plates.

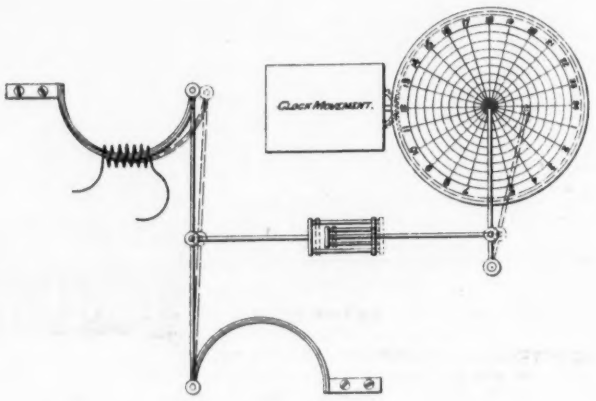
690,589. PLATE FOR SECONDARY BATTERIES; Berthold Kuettner, Woking, Eng. App. filed Aug. 8, 1901. A plate of the Plante type divided into a number of panels by cross bars of diamond shape section, each panel consisting of two sets of ribs of wedge shape, cross section extending from the opposite side to form the depth of the plate and crossing each other at right angles, the sets of ribs being alternately arranged on opposite faces of the plate.

690,594. TRAVELER; A. Lonergan, New York, N. Y. App. filed May 2, 1901. A traveler for threading conduits, having a movable clutch, a bumper connected with the clutch and means for throwing a driver against the bumper to force the traveler along.

690,623. ELECTRICAL CALL APPARATUS; C. Shore, Bolton, Eng. App. filed April 8, 1901. A clock fitted with contacts in connection with a switch-board and call apparatus at various locations, whereby a call can be automatically sent to a particular location by properly plugging-in at the board.

690,639. TROLLEY HARP; F. P. Crockett and O. P. Johnson, Kalamazoo, Mich. App. filed Oct. 21, 1901. Details.

690,649. ELECTRICALLY ILLUMINATED SIGN; J. H. Goehst, Chicago, Ill. App. filed March 21, 1901. A tubular frame surrounding the sign is fitted internally with lamp sockets into which lamps are inserted through



690,059. Registering Meter.

openings in the tube on both sides of the sign to illuminate both faces thereof.

690,651. TELEPHONE ATTACHMENT; H. I. Hauxhurst, Oakland, Calif. App. filed Sept. 11, 1900. (See page 127.)

690,710. GALVANIC BATTERY; Wilhelm Erny, Halle-on-the-Salle, Germany. App. filed Mar. 6, 1901. A primary battery consisting of a vessel having an inner annular recess; the zinc electrode consists of a slotted cylinder with an outer projection at its upper end, which engages in the above-mentioned annular recess, the zinc electrode thus being freely suspended in the vessel.

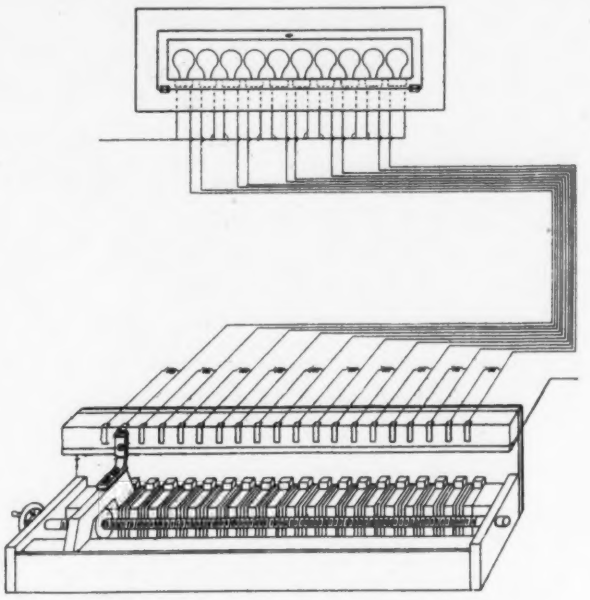
690,750. SPARKING COIL; M. H. Moffett, Cleveland, Ohio. App. filed Feb. 9, 1901. The coil is inclosed in a protective casing having a chamber at one end in which the connections of the terminal wires are made.

690,757. SLEET CLEANING DEVICE FOR TROLLEY ARMS; M. M. Nash, Lowell, Mass. App. filed Nov. 8, 1901. A curved shoe having a scraping blade is adapted to be strapped into the groove of the wheel and held from rotating by engagement with the harp.

690,763. BAG OR SATCHEL LIGHTING DEVICE; W. W. McCormick, Santa Rosa, Calif. App. filed March 2, 1901. A bulls-eye light is set into one end of the satchel and supplied by a battery located in a false bottom of the satchel.

690,770. GALVANIC BATTERY OR PILE; C. J. Reed and M. T. Morrill, Golden, Colo. App. filed July 6, 1899. A dry battery consisting of two or more elements electrically connected in series. The parts are in the form of flat plates superposed one upon the other, and comprised of carbon and zinc electrodes, porous diaphragms are in contact with the zinc, with an electric mixture of smaller area than electrodes between the carbon and the porous diaphragm. The negative electrode of one element is electrically separated from the positive electrode of the adjacent element by an insulating plate or layer.

690,787. INDEPENDENT OPERATING MEANS FOR ELECTRIC



690,800. Battery End Cell Switch Indicator.

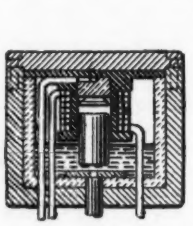
SWITCHES; J. H. Spangler, Crafton, Pa. App. filed April 17, 1901. An automatic electric railway switch provided with means for operating by hand when desired.

690,800. BATTERY END CELL SWITCH INDICATOR; A. C. Walther, Brooklyn, N. Y. App. filed April 19, 1901. An indicator circuit is closed through local lamp circuits successively with an arrangement of resistances such as to reduce the light proceeding from each lamp as the movable part of the indicator reaches certain of its predetermined positions and to permit full candle power at the remaining positions of the indicating device. With this apparatus a ten-lamp indicator will serve for twenty end cells.

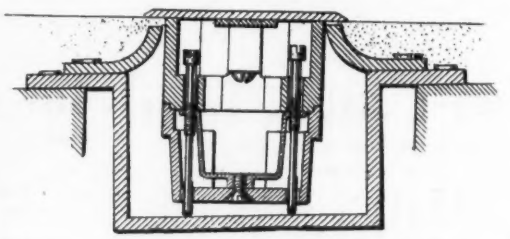
690,807. METHOD OF CONTROLLING ELECTRIC MOTORS OR OTHER ELECTRICAL TRANSLATING DEVICES; G. T. Woods, Parkridge, N. J. App. filed Aug. 27, 1892. (See Current News and Notes.)

690,808. METHOD OF CONTROLLING ELECTRIC MOTORS OR OTHER ELECTRICAL TRANSLATING DEVICES; G. T. Woods, Parkridge, N. J. App. filed March 20, 1895. (See Current News and Notes.)

690,809. APPARATUS FOR CONTROLLING ELECTRIC MOTORS OR



690,386. Electric Railway.



690,479. Electric Switch.

OTHER ELECTRICAL TRANSLATING DEVICES; G. T. Woods, New York, N. Y. App. filed March 28, 1901. (See Current News and Notes.)

690,810. APPARATUS FOR CONTROLLING ELECTRIC MOTORS OR OTHER ELECTRICAL TRANSLATING DEVICES; G. T. Woods, New York, N. Y. App. filed March 28, 1901. (See Current News and Notes.)

690,818. ICE CUTTER FOR TROLLEY WIRES; A. Ambuhl, Decatur, Ill. App. filed Dec. 6, 1900. A slidable ice cutter to be fitted against the front side of the wheel of the trolley pole.

690,856. METHOD OF MAKING GLOWERS FOR ELECTRIC LAMPS; M. W. Hanks, Pittsburg, Pa. App. filed June 7, 1900. The glower blank is subjected to an electric arc formed between carbon electrodes, the products of combustion being withdrawn by suction. In this manner a terminal bead is formed on the end of the glower.

690,886. OPERATING MECHANISM FOR ELECTRIC SWITCHES; J. H. Spangler and R. Herman, Crafton, Pa. App. filed April 17, 1901. Electric railway switch mechanism provided with means for preventing backward motion after actuation of the switch tongue.